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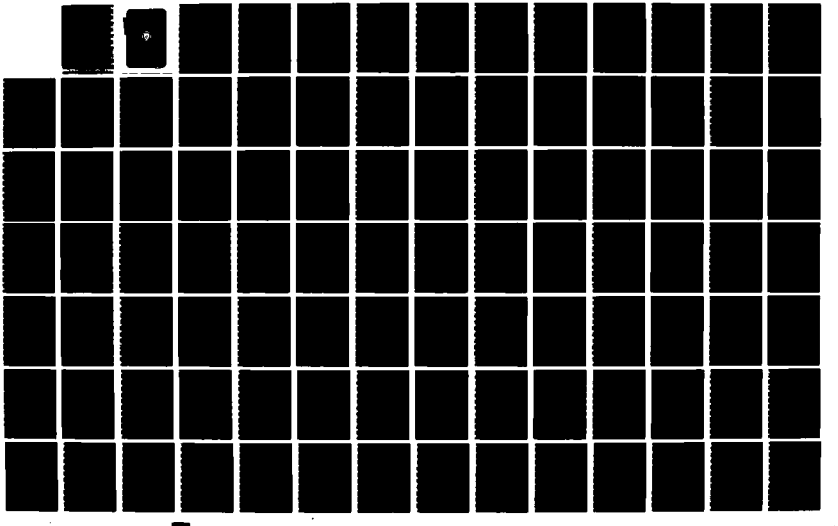

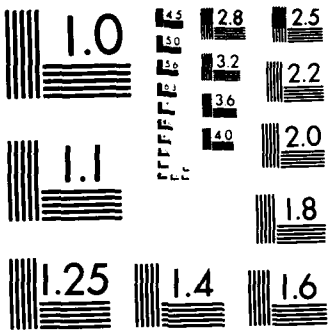

POSTPROCESSORS FOR THE FORCE EVALUATION MODEL (POSTFOR) STUDY

SEPTEMBER 1986

PREPARED BY
RESEARCH AND ANALYSIS SUPPORT DIRECTORATE

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This report documents the work done at CAA in developing automated postprocessors for the Force Evaluation Model (FORCEM). The FORCEM is a computer simulation of land and air combat, logistics, and support in a theater of operations, and is intended to become the primary model for theater campaign simulations in CAA studies. These studies require postprocessor computer programs to extract particular results of the FORCEM campaign simulations and to combine FORCEM simulation results with computerized data from other sources, as required for subsequent analysis. These postprocessors include a force roundout postprocessor that determines the Army combat support and service support units required to support a given combat force, as well as postprocessors that calculate requirements for Army ammunition, fuel, and replacement equipment in wartime. This report describes the methodology adopted for each FORCEM postprocessor and also serves as a user's manual for the computer programs developed as postprocessors to the FORCEM.

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STUDY REPORT
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POSTPROCESSORS FOR THE FORCE EVALUATION MODEL (POSTFOR) STUDY

September 1986

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Prepared by

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CAA	POSTPROCESSORS FOR THE FORCE EVALUATION MODEL (POSTFOR) STUDY	STUDY SUMMARY CAA-SR-86-10

THE REASON FOR PERFORMING THE STUDY is to ensure that postprocessors for the Force Evaluation Model (FORCEM) are available for the use of FORCEM as the primary model for force-level studies performed by the US Army Concepts Analysis Agency (CAA).

THE PRINCIPAL FINDINGS of this study are:

(1) All of the data required by the existing Concepts Evaluation Model (CEM) postprocessors either are already available from the FORCEM output reports or can be generated through the modification of FORCEM and the creation of new reports from FORCEM, with the exception of data concerning the displacement of the forward edge of the battle area (FEBA), for which a surrogate measure must be used.

(2) All the existing CEM postprocessors should be retained, with such modifications as necessary to permit them to accept campaign simulation data in the FORCEM report formats, except for the existing Ammunition Postprocessor (APP) which is to be replaced. The computation of all ammunition consumption in losses aboard damaged vehicles, logistic losses, function checks, registration, zeroing, and expenditures against enemy targets, suspect targets, for rear area security, and for harassment and interdiction is to be performed in FORCEM itself, rather than in the APP.

(3) Consistency between FORCEM and its postprocessors can be achieved by: (a) calculating expenditures of air defense munitions in FORCEM, thus eliminating the need to repeat the modeling of tactical aircraft sorties in a postprocessor; (b) modifying FORCEM to make its replacement of damaged equipment while in repair consistent with the Combat Operational Readiness Float Factors Postprocessor; (c) revising the casualty stratification process to take account of whatever degree of personnel stratification is available from FORCEM; (d) examining how the support force requirements model can be made to accept and use the workloads of intratheater transportation, maintenance, and other combat service support generated by FORCEM and to dispense with recomputing these workloads; and (e) ensuring that the inputs to FORCEM concerning the capabilities and productivity of support forces agree with the assumptions of the force roundout postprocessor.

THE MAIN ASSUMPTION upon which this study is based is that FORCEM correctly calculates the quantities of munitions of each weapon fired at enemy targets and destroyed aboard vehicles hit by enemy fire.

THE PRINCIPAL LIMITATION of the work is the linking of FORCEM to the existing Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS) rather than developing a new support force requirements model better suited to FORCEM.

THE SCOPE OF THE STUDY includes those postprocessors and output data needed for force capability studies, support force requirements analyses, and ammunition, materiel, and fuel requirements studies.

THE STUDY OBJECTIVES are:

(1) Determine the output data needed for studies using FORCEM.

(2) Ensure that these data are available, by retaining existing postprocessors, or by developing new postprocessors.

(3) Link FORCEM to retained and new postprocessors.

(4) Test FORCEM with postprocessors and verify results.

(5) Make recommendations for long-term methodology improvement.

THE BASIC APPROACH followed in this study was to develop a new ammunition requirements postprocessor, moving most of the computations from the existing APP into FORCEM, and to develop linkage routines from FORCEM to all other existing postprocessors.

THE STUDY SPONSOR is the Director, US Army Concepts Analysis Agency (CAA)

THE STUDY EFFORT is directed by Dr. Ralph Johnson, who is assisted by Dr. James Metzger, Mr. Norig Asbed, Mr. Arthur Paarmann, Mr. Raymond McDowall, Mr. Peter Byrne, and Ms. Renee Carlucci.

COMMENTS AND QUESTIONS may be sent to the Assistant Director for Research and Analysis Support, US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, MD 20814-2797.

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CHAPTER 1

EXECUTIVE SUMMARY

1-1. PURPOSE. The purpose of this report is to document the work done at the US Army Concepts Analysis Agency (CAA) in the Postprocessors for the Force Evaluation Model (POSTFOR) Study. Thus, this report describes the work of the POSTFOR Study and also serves as a user's manual for the computer programs developed in the POSTFOR Study, which is essentially a computer software development effort.

1-2. BACKGROUND

a. The Force Evaluation Model (FORCEM) is a computer simulation model representing combat, combat support (CS), and combat service support (CSS) in a theater of operations. FORCEM has been developed and tested over the period March 1982 through December 1985, and has made the transition to operational use in the OMNIBUS 85 Study. FORCEM is intended to become the primary fully automated model for theater campaign simulations in CAA studies, to supplant the Concepts Evaluation Model (CEM). FORCEM is designed to be the theater component of a US Army hierarchy of combat simulation models. FORCEM represents CS and CSS functions and theater rear area operations in considerably greater detail than CEM.

b. Since 1974 CEM has been employed in simulating theater campaigns for studies of Army requirements, force planning, and force capabilities at CAA. Over that time, various postprocessor computer programs have been developed to reformat, to display graphically, to summarize, and to extract particular results of the CEM campaign simulations and to combine CEM simulation results with computerized data from other sources, as required for subsequent analysis to accomplish the objectives of the studies. Postprocessors can be defined as those computer routines that extract data from the campaign simulation and process the data to meet the objectives of a study. The CEM postprocessors include, for example, a support force requirements model which determines CS and CSS units required to perform the support functions demanded by the Army combat elements in a simulated theater campaign. Another CEM postprocessor determines the ammunition consumption rates for each type of munition, by time period, based on the results of a theater campaign simulation.

c. In order for FORCEM to assume the role that CEM has filled as the primary computer model for theater campaign simulations in support of the wide variety of CAA studies, automated methods must be available to perform the same functions using the results of FORCEM simulations as performed by the CEM postprocessors. In other words, now that FORCEM is to be used instead of CEM in these studies, postprocessors for FORCEM are needed to perform those functions. It is also necessary to develop FORCEM postprocessors to perform functions that have not been required in past

studies using CEM but are necessary for anticipated CAA studies, such as air defense missile requirements. The POSTFOR Study was organized to determine what postprocessors are required and to develop and test those postprocessors.

d. In developing postprocessors for FORCEM, certain existing CEM postprocessors have been found to be appropriate for retention and use with FORCEM. For each of these retained CEM postprocessors, computer routines were developed to extract from FORCEM reports the data required by the CEM postprocessor and to format the FORCEM data in CEM report formats. For other CEM postprocessors it is more appropriate to develop a new methodology to perform the postprocessor's function (to take advantage of the more detailed representation in FORCEM of certain battlefield functions) rather than retaining the CEM postprocessor.

1-3. STUDY TERMS OF REFERENCE

a. Purpose. The purpose of the POSTFOR Study is to ensure that postprocessors for FORCEM are available for its use as the primary campaign simulation model for force-level studies performed by CAA.

b. Objectives

(1) Determine the output data needed for studies using FORCEM.

(2) Ensure that the necessary output data for studies are available, by retaining (and possibly modifying) existing postprocessors, or by developing new postprocessors.

(3) Link FORCEM to retained and new postprocessors.

(4) Test FORCEM with postprocessors, and verify that results are "sensible."

(5) Make recommendations for long-term methodology development.

c. Scope. This study is limited to the output data and postprocessors needed by the OMNIBUS studies, Total Army Analysis (TAA) or Support Force Requirements Analysis studies, and requirements studies performed by CAA. In particular, the study addresses the following types of theater campaign model postprocessor data.

(1) Force roundout data; that is, the determination of the CS and CSS units needed to perform the support functions demanded by a given combat force, as calculated in the existing Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS).

(2) Analysis of casualties, as performed by the existing Patient Flow Model (PFM) and Casualty Stratification Model (CSM) postprocessors, which require output data from FASTALS as well as from the theater campaign simulation.

(3) Requirements for ammunition, as produced by the existing Ammunition Postprocessor (APP).

(4) Wartime replacement factors (WARF) for equipment; that is, the requirements for replacements for equipment irreparably damaged in combat.

(5) Wartime fuel consumption factors, as produced by the existing Fuel Factor Development Postprocessor.

(6) Combat operational readiness float (CORF) factors for equipment; that is, the requirements for equipment damaged in combat until the equipment is returned from repair, as determined by the existing CORF Factors Postprocessor.

(7) Requirements for air defense missiles, as produced by the developmental Air Defense Missile Postprocessor.

(8) Graphic display of campaign results, as produced by the existing Automated Data Display of CEM Output Program (ADDCOP).

d. Sponsor. The sponsor of the POSTFOR Study is the Director, CAA.

e. Study Directive. The tasking directive of the POSTFOR Study is reproduced at Appendix B.

1-4. REPORT STRUCTURE

a. Chapter 2 of this report describes the treatment of the support force requirements model and casualty analysis postprocessors in the POSTFOR Study.

b. Chapter 3 describes the interface that has been developed between the FORCEM and the ADDCOP plotter graphics.

c. Chapter 4 explains how FORCEM has been linked to the WARF, CORF factors, and fuel factors postprocessors.

d. Chapter 5 describes FORCEM ammunition requirements and air defense missile requirements methodology.

e. Chapter 6 presents recommendations for long-term methodology development of FORCEM and its postprocessors.

f. Chapter 7 addresses the essential elements of analysis (EEA) of the POSTFOR Study.

g. Appendix D provides documentation of the FORCEM reports mentioned in this report.

h. Appendix E is a brief documentation of the ADDCOP graphics routine, useful when reading Chapter 3 of this report.

1-5. SUMMARY OF FINDINGS. The research was guided by four EEA, as provided by the study directive (Appendix B). Summary answers to these questions are as follows:

a. What data are already available from FORCEM output reports, and what can be generated through the modification of the FORCEM and the creation of new reports from the FORCEM? All of the data required by the postprocessors under consideration either are already available from FORCEM output reports or can be generated by the modification of FORCEM and the creation of new reports from FORCEM, with the exception of forward edge of the battle area (FEBA) displacement data, for which a surrogate measure must be used.

b. Which existing postprocessors for the CEM should be retained (and possibly modified), and which should be replaced? All the existing CEM postprocessors should be retained, with such modifications as necessary to permit them to accept campaign simulation data in the FORCEM report formats, except for the existing APP, which should be replaced.

c. What computations performed in a postprocessor of the CEM should be performed in FORCEM itself? The computation in the existing APP of all categories of ammunition consumption except sea losses should be performed in FORCEM itself.

d. Where FORCEM and a retained postprocessor both represent an activity, with perhaps differing methodologies, what can be done to achieve consistency? Consistency between FORCEM and its postprocessors can be enhanced by:

(1) Performing the computation of all ammunition consumption but sea losses in FORCEM and removing from the ammunition postprocessor all computation of requirements that are computed in FORCEM;

(2) Calculating air defense munitions expenditures in FORCEM, rather than repeating the modeling of tactical air sorties in a postprocessor.

(3) Modifying FORCEM to make its representation of the replacement of damaged equipment while in repair consistent with the CORF Factors Postprocessor;

(4) Revising the casualty stratification process to take account of whatever degree of personnel stratification is available from FORCEM;

(5) Examining how the support force requirements model can be made to accept and use the workloads of intratheater transportation, maintenance, and other CSS functions generated by FORCEM, rather than recomputing the workloads; and

(6) Ensuring that the inputs to FORCEM concerning the capabilities and productivity of support forces agree with the assumptions of FASTALS.

CHAPTER 2

SUPPORT FORCE REQUIREMENTS

2-1. INTRODUCTION. This chapter describes how FASTALS, the existing support force requirements model, has been linked to FORCEM. The post-processors to FASTALS which treat personnel casualties, such as the Patient Flow Model and Casualty Stratification Model, do not require any data from the campaign simulation other than what FASTALS requires, so the linkage between FORCEM and the casualties postprocessors is accomplished when FASTALS is linked to FORCEM.

2-2. LINKAGE TO FASTALS. The existing FASTALS has been retained, and the POSTFOR Study has developed and tested linkage routines to provide FASTALS with the same data from FORCEM as the data provided to FASTALS by CEM, except for the calculation of FEBA displacement. Described in this chapter are four routines which process output from FORCEM to produce the reports, formerly provided by CEM, needed to run FASTALS, as indicated by Table 2-1. All of the required reports, except the Logreader Report, have exactly the same format as those previously provided by CEM. The only FASTALS routine to read the Logreader Report, the CT-Table routine, has been modified to accommodate the changes in the Logreader Report. Thus the FASTALS operator must select CT-TABLE-FOR from the interactive FASTALS menu to read FORCEM data.

Table 2-1. FORCEM-FASTALS Interface

Data file for FASTALS input	Postprocessor routine	FORCEM report that furnishes data
FEBA loss report	FEBA LOSS	Combat Headquarters (R28)
Logreader report	LOGREADER	Loss and Consumption (R64)
Blue personnel report	PERSRPT	Loss and Consumption (R64)
Division combat intensity report	INTNSTY	Division Equipment (R51)

2-3. FEBALOSS REPORT. One report that FASTALS requires as input gives the average distance, over each specified sector of the theater front, that the friendly forces have advanced from their initial (D-day) positions. CEM has a well-defined forward FEBA, continuous across the theater front, so the average distance the FEBA has moved is readily obtained in CEM. In FORCEM, however, the "FEBA" is not continuous, as forces can be bypassed or encircled. A surrogate measure of FEBA displacement is used in supporting FASTALS, namely, the distance that the average front location of the online Blue corps within the FASTALS sector has moved since D-day. This measure is obtained from the FORCEM Combat Headquarters - Part 1 (R28) Report.

a. The POSTFOR Study has designed, implemented, and tested a SIMSCRIPT routine, called FEBALOSS, which reads the FORCEM R28 Report and writes a report identical to the FEBALOSS Report obtained from CEM, ready for input to FASTALS. A sample of the FEBALOSS Report is shown in Figure 2-1.

DAY	AVERAGE FEBA LOSS SECTOR 1	SECTOR 2	SECTOR 3
10	-27.3	-20.3	-21.6
20	-32.2	-24.4	-24.8
30	-34.3	-26.3	-26.2
40	-39.2	-30.4	-32.
50	-39.2	-30.4	-32.
60	-39.2	-30.4	-32.
70	-39.2	-30.4	-32.
80	-39.2	-30.4	-32.
90	-39.2	-30.4	-32.
100	-39.2	-30.4	-32.
110	-39.2	-30.4	-32.
120	-39.2	-30.4	-32.
130	-39.2	-30.4	-32.
140	-39.2	-30.4	-32.
150	-39.2	-30.4	-32.
160	-39.2	-30.4	-32.
170	-39.2	-30.4	-32.
180	-39.2	-30.4	-32.

Figure 2-1. Sample FORCEM FEBALOSS Report

b. This program reads the R28 Report from unit SIMU12 and writes the FEBALOSS Report to unit SIMU13. A sample runstream of the FEBALOSS program is shown in Figure 2-2. The FEBALOSS program reads from the system input stream the following parameters (as free-formatted integers):

(1) The number of FASTALS sectors in the theater (line 11 of Figure 2-2).

```
 1:@RUN  A171FB,F1385T 3043Z,SECRET,1C,5CJ
 2:@USE  F.,12FASTALS/   /   .
 3:@ASG,A  F.
 4:@USE  SIMU12.,71-01 1440R28/   .
 5:@FREE  SIMU13.
 6:@ASG,A  SIMU12.
 7:@USE  P.,UNCLASSIFIED*71PFOR.
 8:@ASG,A  P.
 9:@ASG,T  SIMU13.
10:@XQT  P.365FEBAL
11:3
12:5
13:1100
14:1200
15:1300
16:1400
17:1600
18:2
19:2200
20:2400
21:2
22:2500
23:2700
24:
25:240
26:240
27:840
28:@ASG,A  UNCLASSIFIED*22FASTALS.
29:@ED  SIMU13.,F.FEBALOSS/14JAN86
30:A@C*  UNCLASSIFIED*22FASTALS.FEBAMAP
31:EXIT
32:@FIN
```

Figure 2-2. Sample Runstream of the FORCEM FEBALOSS Postprocessor

(2) For every FASTALS sector:

(a) The number of Blue FORCEM units (corps) to be assigned to the sector (for example, lines 12, 18, and 21 of Figure 2-2).

(b) For each Blue corps headquarters unit in the sector, the unit's FORCEM identification number (lines 13-17, 19-20, 22-23 of Figure 2-2).

(3) The time (in hours) of D-day, H-hour in the FORCEM simulation, that is, the number of hours simulated before D-day (line 25 of Figure 2-2).

(4) The length (in hours) of the FASTALS time period (normally 240 hours as in line 26 of Figure 2-2).

(5) The beginning hour of the last FORCEM cycle simulated (line 27 of Figure 2-2).

c. Blank lines (for example, line 24 of Figure 2-2) may be interspersed as separators, or several inputs can be combined on a line, since these inputs are free-formatted.

d. The FORCEM FEBALOSS routine calculates average FEBA displacement for each sector at the end of each FASTALS time period as the distance that the average front location of the sector's Blue corps has moved since D-day, where the D-day average location is taken over those corps in the sector that are online at D-day and the average location at the end of each time period is taken over those corps in the sector that are online at the end of the time period.

2-4. LOGREADER REPORT. From the CEM Logreader Report FASTALS obtains data on American ammunition consumed and on repairable combat losses of American tanks and armored personnel carriers (APC). A Logreader routine was developed in SIMSCRIPT by the POSTFOR Study to provide the same data from FORCEM to FASTALS, in virtually the same format. A sample of the Logreader Report produced from a FORCEM simulation is shown in Figure 2-3.

a. A sample runstream of the Logreader is shown in Figure 2-4. The FORCEM Logreader reads the FORCEM Loss and Consumption (R64) Report from unit SIMU20 (lines 2-3 of Figure 2-4). The Logreader Report for input to FASTALS is written to unit SIMU21. The FORCEM Logreader program reads, from the computer system input stream, the following inputs:

(1) The number of days per FASTALS time period (line 11 of Figure 2-4), input as a free-formatted integer.

(2) The number of hours simulated before D-day (line 12 of Figure 2-4), input as a free-formatted integer.

(3) For each of the ten reporting categories--US tanks, APCs, helicopters, antitank/mortars, artillery, personnel, tank ammunition, artillery ammunition, other ammunition, and fuel--in this order, as on lines 13-32 of Figure 2-4:

(a) A category name (between one and six characters with no internal blanks);

(b) The number of FORCEM assets (a free-formatted integer) included in this category (zero indicates the Logreader Report is to exclude this category.); and

(c) A list of the FORCEM asset numbers included in this category.

FORCEM LOGREADER

COLUMN NUMBER DEFINITIONS FOR THIS REPORT

COL 1 = QUANTITY AUTHORIZED
COL 2 = QUANTITY ON HAND
COL 3 = TEMPORARY COMBAT LOSSES
COL 4 = PERMANENT COMBAT LOSSES
COL 5 = TOTAL COMBAT LOSSES
COL 6 = TEMPORARY NON-COMBAT LOSSES
COL 7 = PERMANENT NON-COMBAT LOSSES
COL 8 = TOTAL LOSSES, ALL SOURCES
COL 9 = TOTAL TEMPORARY LOSSES, ALL SOURCES
COL 10 = TOTAL PERMANENT LOSSES, ALL SOURCES
COL 11 = TOTAL RETURNING FROM REPAIR
COL 12 = TOTAL IN REPAIR THIS CYCLE

CATEGORY = TANKS

DAY	1	2	3	4	5	6	7	8	9	10	11	12
0	3361	3074	0	0	0	0	0	0	0	0	0	0
10	5365	5029	0	0	0	784	0	784	784	0	4955	49
	0	0	0	0	0	784	0	784	784	0	4955	49
20	5305	3736	1166	203	1369	655	0	2024	1821	203	1649	690
	0	0	1166	203	1369	1439	0	2808	2605	203	6604	739
30	6497	4400	528	41	569	580	0	1149	1108	41	1733	973
	0	0	1694	244	1938	2019	0	3957	3713	244	8337	1712
40	6959	4583	210	1	211	643	0	854	853	1	941	1228
	0	0	1904	245	2149	2662	0	4811	4566	245	9278	2940
50	7301	4840	128	0	128	658	0	786	786	0	905	1286
	0	0	2032	245	2277	3320	0	5597	5352	245	10183	4226

Figure 2-3. Sample FORCEM Logreader Report

The assets included in these Logreader categories need not agree with the FORCEM categorizations. Thus, for example, the Logreader could be made to report assets 11, 12, 13, 14, 33, and 46 as APCs even though assets 11, 12, 33, and 46 are not treated as APCs in FORCEM. If the same FORCEM asset number appears in more than one category, it will be reported in only the first category in which it appears; hence, the Logreader categories should be mutually exclusive. The asset numbers are input as free-formatted integers, separated by blanks (lines 14, 16, 18, 20, 22, 24, 26, 28, 30, 32 of Figure 2-4).

```
 1      @RUN A271LR,F1385T3D432,SECRET,2D,5DD
 2      @USE SIMU2D.,V6-D5D919R64/  /  .
 3      @ASG,A SIMU2D.
 4      @USE F.,12FASTALS/  /  .
 5      @ASG,A F.
 6      @FREE SIMU21.
 7      @USE P.,UNCLASSIFIED*71PFOR.
 8      @ASG,A P.
 9      @ASG,T SIMU21.
10      @XQT P.385LOGREAD
11      10
12      24D
13      TANKS   2
14      1  2
15      APCS    4
16      13  14  15  16
17      HELIS   1
18      25
19      AT/M    4
20      3D  31  32  33
21      ARTY    4
22      43  44  45  46
23      PERS    4
24      121  123  125  144
25      TKAMMO  1
26      146
27      ARTAMM  1
28      148
29      AMMO    1
30      152
31      POL     1
32      154
33      @ED SIMU21.,F.USLOGREAD/9MAY86
34      EXI
35      @FIN
```

Figure 2-4. Sample Runstream of FORCEM Logreader

b. Data from the FORCEM R64 Report, which is described in Appendix D, are processed in the following manner to produce the Logreader Report. For ammunition data, which are reported in 100-pound units, all fields are divided by 20 to yield short tons (STON). For petroleum, oils, and

lubricants (POL) data reported in 1,000-gallon units, all fields are divided by 0.2861 to yield short tons. The 12 columns of the Logreader Report are computed as follows:

(1) The authorized level is obtained from R64 record type 1, field 8. According to FORCEM documentation, this includes all FORCEM units, but excludes authorizations of convoys and personnel and equipment pools.

(2) The onhand level is obtained from R64 record type 1, field 9. This represents the status at the end of each cycle, after combat and resupply and replacements.

(3) Temporary combat losses are obtained from R64 record type 2, field 9. This statistic, for tanks and APCs, is the principal factor used from the campaign simulation by FASTALS in determining maintenance unit workloads.

(4) Permanent combat losses are obtained from R64 record type 2, field 8.

(5) Total combat losses are the sum of columns 3 and 4, described above.

(6) Temporary noncombat losses are obtained from R64 record type 2 field 11.

(7) Permanent noncombat losses are obtained from R64 record type 2, field 10.

(8) Total losses are the sum of columns 3, 4, 6, and 7.

(9) Total temporary losses are the sum of columns 3 and 6.

(10) Total permanent losses are the sum of columns 4 and 7.

(11) Returns from repair (or from hospitals, in the case of personnel) are obtained from R64 record type 3, field 9.

(12) The quantity in repair is obtained from R64 record type 1, field 10.

2-5. BLUE PERSONNEL REPORT. FASTALS obtains fairly detailed information concerning the personnel casualties, by national partition, occurring in the campaign simulation, and their subsequent medical treatment, from the Blue Personnel Report. A SIMSCRIPT postprocessor, PERSRPT, has been developed by the POSTFOR Study to produce the Blue Personnel Report from FORCEM results. A sample of the Blue Personnel Report obtained from FORCEM is shown in Figure 2-5.

FORCEM BLUE PERSONNEL DETAIL REPORT
OCCURENCES DURING EACH DAY (FIRST LINE) AND CUMULATIVE TOTALS FOR THE WAR AT THE END OF THE DAY(SECOND LINE)

DAY	COMBAT LOSSES				NON-COMBAT LOSSES			TOTALS (COMBAT + NON-COMBAT)				
	KIA	WIA (NOT INCLDG AID STA)	CMIA	TOTAL	DEAD	SICK	TOTAL	DEAD	ENTERED IN-THTR HOSPITAL	EVAC. FROM THEATER	TOTAL HOSPITALZD	TO AID STATION ONLY
34 (P1)	87. 4309.	139. 9421.	8. 539.	234. 14294.	0. 0.	387. 14964.	387. 14964.	87. 4309.	526. 23915.	0. 0.	526. 23915.	90. 2771.
34 (P2)	348. 26069.	628. 27196.	48. 3760.	1024. 57025.	0. 0.	756. 29742.	756. 29742.	348. 26069.	1384. 56938.	0. 0.	1384. 56938.	186. 8151.
34 TOT	935. 30373.	767. 36647.	56. 4299.	1258. 71319.	0. 0.	1143. 44206.	1143. 44206.	935. 30373.	1910. 80853.	0. 0.	1910. 80853.	226. 10922.
35 (P1)	87. 4391.	138. 9589.	7. 546.	232. 14526.	0. 0.	389. 14848.	389. 14848.	87. 4391.	522. 24437.	0. 0.	522. 24437.	32. 2810.
35 (P2)	330. 26399.	605. 27801.	47. 3807.	982. 58007.	0. 0.	843. 30585.	843. 30585.	330. 26399.	1448. 58386.	0. 0.	1448. 58386.	193. 8333.
35 TOT	917. 30790.	743. 37390.	54. 4353.	1214. 72533.	0. 0.	1227. 45433.	1227. 45433.	917. 30790.	1970. 82823.	0. 0.	1970. 82823.	221. 11143.
36 (P1)	88. 4479.	140. 9729.	7. 553.	231. 14757.	0. 0.	382. 15230.	382. 15230.	88. 4479.	522. 24959.	0. 0.	522. 24959.	39. 2849.
36 (P2)	311. 26710.	554. 28355.	44. 3851.	909. 58916.	0. 0.	1082. 31667.	1082. 31667.	311. 26710.	1636. 60022.	0. 0.	1636. 60022.	165. 8998.
36 TOT	395. 31185.	694. 38084.	51. 4404.	1140. 73673.	0. 0.	1464. 46897.	1464. 46897.	395. 31185.	2158. 84981.	0. 0.	2158. 84981.	209. 11347.
37 (P1)	160. 4635.	120. 9849.	19. 572.	299. 15056.	0. 0.	387. 15617.	387. 15617.	160. 4635.	507. 25966.	0. 0.	507. 25966.	35. 2884.
37 (P2)	340. 27050.	581. 28936.	48. 3899.	969. 59885.	0. 0.	876. 32543.	876. 32543.	340. 27050.	1457. 61479.	0. 0.	1457. 61479.	173. 8671.
37 TOT	500. 31685.	701. 38785.	67. 4471.	1268. 74941.	0. 0.	1263. 48160.	1263. 48160.	500. 31685.	1964. 86945.	0. 0.	1964. 86945.	208. 11555.

Figure 2-5. Sample Blue Personnel Report

a. A sample runstream for the PERSRPT program is shown in Figure 2-6. The PERSRPT program reads the FORCEM Loss and Consumption (R64) Report, described in Appendix D, as unit SIMU20 (lines 7-9 of Figure 2-6). PERSRPT reads from the system input stream the number of FORCEM national partitions to report and the time in hours of D-day (line 12 of Figure 2-6), followed by, for each partition requested, the FORCEM partition number and the label (four characters) for the partition in the Blue Personnel Report (lines 13-14 of Figure 2-6). Three partitions are currently defined--US, non-US Blue, and Red forces. These are followed by the number of FORCEM personnel asset numbers to include in the Blue Personnel Report (line 15 of Figure 2-6), followed by the list of FORCEM asset numbers (line 16 of Figure 2-6). PERSRPT writes the Blue Personnel Report to unit SIMU21.

```
 1:@RUN A271PR,F138ST3043Z,SECRET,20,500
 2:@QUAL UNCLASSIFIED
 3:@USE F.,12FASTALS/  /  .
 4:@ASG,A F.
 5:@USE P.,*71PFOR.
 6:@ASG,A P.
 7:@USE SIMU20.,12-031140R64/  /  .
 8:@ASG,A SIMU20.
 9:@FREE SIMU21.
10:@ASG,T SIMU21.
11:@XQT P.385PERSRPT/ASSET
12:2  240
13:1 (P1)
14:2 (P2)
15:8
16:121 122 123 124 125 126 144 145
17:@ED SIMU21.,F.BLUPERS/ASSET
18:EXI
19:@FIN
```

Figure 2-6. Sample Runstream for Blue Personnel Report

b. The PERSRPT program processes the R64 report by selecting only records pertaining to those assets listed as input. The operator can select by asset number whichever subcategories and types of personnel he decides are appropriate as input to FASTALS. The national partition of the personnel is determined by field 2 of each R64 record. The 12 columns of the Blue Personnel Report are calculated as follows:

(1) Personnel killed in action are obtained from R64 record type 2, field 8, minus record type 3, field 8.

(2) Personnel wounded in action, excluding aid station (and division clearing station) returns to duty, are obtained from R64 record type 2, field 9, minus record type 2, field 12.

(3) Personnel captured and missing in action are obtained from R64 record type 3, field 8.

(4) Total combat losses are the sum of columns 1, 2, and 3.

(5) Noncombat dead are obtained from R64 record type 2, field 10.

(6) Sick are obtained from R64 record type 2, field 11.

(7) Total noncombat losses are the sum of columns 5 and 6.

(8) Total dead is the sum of columns 1 and 5.

(9) The casualties entering in-theater hospitals are the sum of columns 2 and 6 minus R64 record type 3, field 10. This number can be negative, because the evacuations in FORCEM can be reported in a later day than the day the personnel become wounded or sick. This column is better described as the net gain of patients by theater hospitals.

(10) Personnel evacuated from theater are obtained from R64 record type 3, field 10.

(11) Total personnel hospitalized is the sum of columns 2 and 6.

(12) "To aid station only" is obtained from R64 record type 2, field 12.

2-6. DIVISION INTENSITY REPORT. FASTALS reads from the Division Intensity Report, for each division for each FASTALS (10-day) time period, the number of days spent in each of four combat-loss intensities and the average combat personnel state as a percentage of authorized strength.

a. A sample of this report is shown in Figure 2-7. For example, the first line of Figure 2-7 contains the FORCEM number 1101 of an American division. The first four (two-column) fields of the second line, "5 5 00," indicate that this division spent, of the first ten days of combat, five days in high intensity and five days in normal intensity. The fifth field, "86," of the second line of Figure 2-7, indicates that the average combat personnel strength for the first ten days of combat for this division is 86 percent of authorized. The next five fields of the second line of Figure 2-7 "5 5 0 088" indicate that for the second ten days of combat, this division spent five days in high intensity and five days in normal intensity, with average combat personnel strength 88 percent of authorized. Figure 2-7 indicates that this division spent, from D+20 to D+29, six days in normal intensity and four days in reduced intensity, and so forth.

b. The POSTFOR Study developed a SIMSCRIPT postprocessor, called INTNSTY, to provide the Division Intensity Report from FORCEM results. As an option, the INTNSTY program can write to the Division Intensity Report an additional line for each division, containing the percentage onhand each FASTALS time period of the division's tanks, APCs, and artillery, to support the "attrited-force" mode of FASTALS. FORCEM was also modified to report the percent onhand of division combat personnel in the Division Equipment (R51) Report.

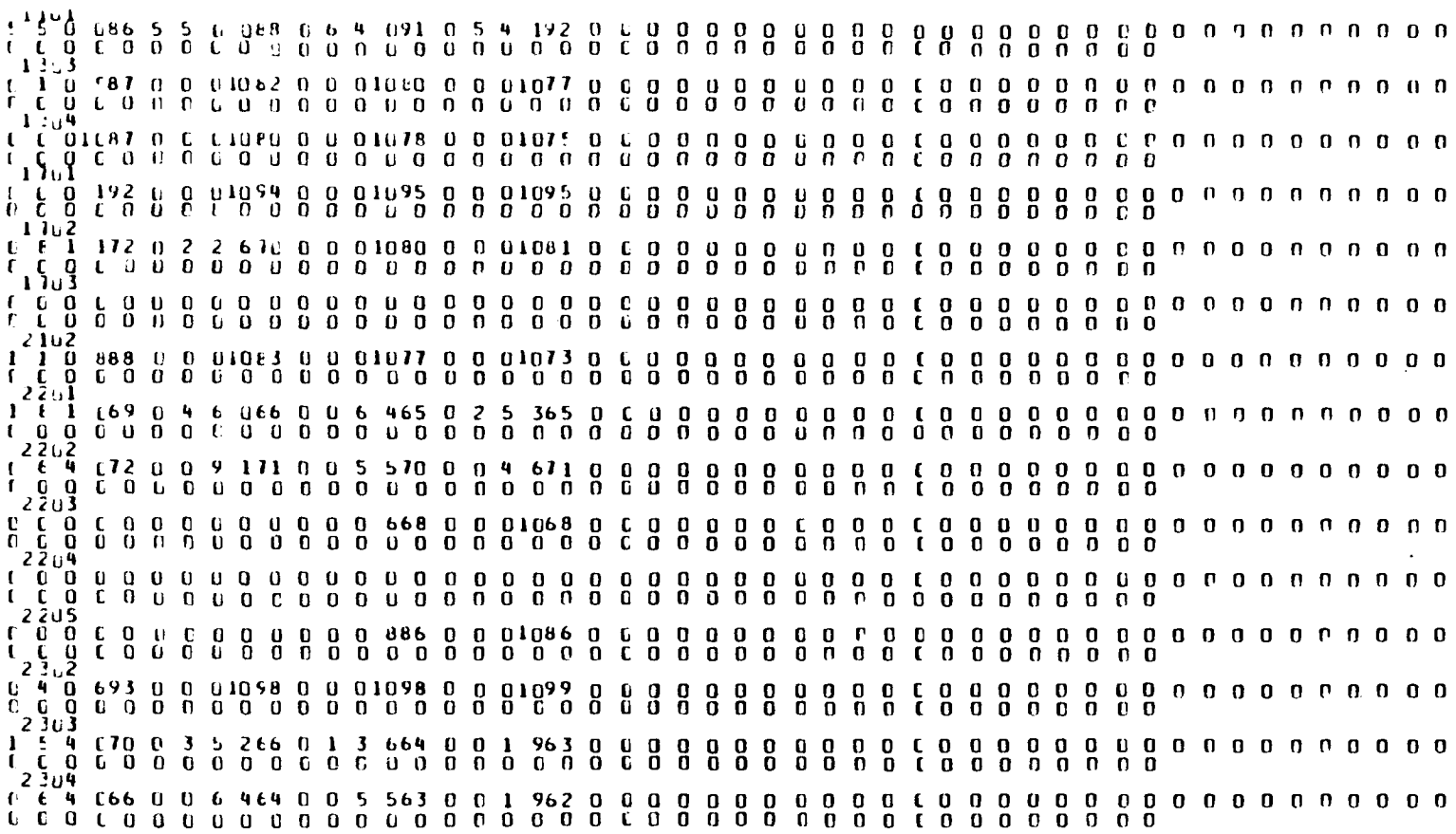


Figure 2-7. Sample Division Intensity Report

c. The INTNSTY program writes the Division Intensity Report to unit SIMU56. A sample runstream for the INTNSTY program is shown in Figure 2-8.

```
1:1105
2:2105
3:1205
4:2205
5:2206
6:1304
```

Figure 2-8. Sample Runstream for Division Intensity Program

d. The INTNSTY program reads the FORCEM Division Equipment (R51) Report, described in Appendix D, as unit SIMU8 (lines 12-13 of Figure 2-8). INTNSTY also reads, from unit SIMU7 (lines 10-11 of Figure 2-8), an Arrivals file. This Arrivals file contains a list (in free format integer numbers) of the FORCEM identification numbers of all the arriving units (divisions) that are to be reported in the Division Intensity Report. A sample of the Arrivals file is shown in Figure 2-9. Some arriving divi- sions may not arrive in time to appear in the R51 Report before the end of the FORCEM simulation. Listing the arriving divisions in the Arrivals file ensures that they appear in the Division Intensity Report that is used by FASTALS.

```
 1:@RUN A17151,F1385T3043Z,SECRET,20,500
 2:@QUAL UNCLASSIFIED
 3:@USE F.,12FASTALS/  /  .
 4:@ASG,A F.
 5:@USE P.,#71PFOR.
 6:@ASG,A P.
 7:@FREE SIMU7.
 8:@FREE SIMU8.
 9:@FREE SIMU56.
10:@ASG,T SIMU7.
11:@ED F.ARRIVALS,SIMU7.
12:@USE SIMU8.,12-031 130R51/  .
13:@ASG,A SIMU8.
14:@ASG,T SIMU56.
15:@XQT P.385INTNSTY
16:
17:.07
18:
19:.03
20:
21:.01
22:
23:10
24:
25:11
26: 1
27:@ED SIMU56.,F.INTSTY/14JAN86
28:EXI
29:@FIN
```

Figure 2-9. Sample INTNSTY Arrivals File

e. From the system input stream the INTNSTY program reads three intensity thresholds (lines 17-21 of Figure 2-8), the length in days of a FASTALS time period (a free-formatted integer, line 23 of Figure 2-8), the simulation day that combat begins (D-day, a free-formatted integer, line 25 of Figure 2-8), and a selector switch for the attrition version of FASTALS (1 for attrition version, 0 for standard FASTALS, line 26 of Figure 2-8). The three intensity thresholds are fractions that are input as real numbers, with free format, the largest first. The three thresholds, which are daily loss rates, between 0 and 1, are compared with the loss rate of each division each day to determine whether the division's combat intensity for the day is high (i.e., above the first threshold), normal (between the first and second thresholds), reduced (between the second and third thresholds), or reserve (below the third threshold). The loss rate for a division is given by

$$LR = (CW1 - CW2 + CW3 - CW4)/CW1,$$

where CW1 is the onhand combat worth of the division (field 19 of the R51 report) at the beginning (R51 field 4 = 1) of the first 12-hour cycle of the day; CW2 is the onhand combat worth after combat (R51 field 4 = 4) of the first cycle of the day; CW3 is the onhand combat worth at the beginning (R51 field 4 = 1) of the second 12-hour cycle of the day; and CW4 is the onhand combat worth after combat of the second cycle of the day.

f. The INTNSTY program reports for each unit specified by input in the Arrivals file and for each division found in the FORCEM R51 report whose national partition (field 3) is one (US forces). For each FASTALS time period (usually ten days) the Division Intensity Report contains the number of days spent in high, normal, reduced, and reserve intensities (in that order), followed by the division's average combat personnel state (in percent). The average combat personnel state is calculated as the average of the R51 report field 21, at the beginning (R51 field 4 = 1) of the first cycle of each day, averaged over the days of the FASTALS time period.

2-7. OPERATIONAL TESTING

a. A test of the FORCEM-FASTALS linkage was conducted using the results of a FORCEM simulation of 30 days of combat in Europe. The inputs to FORCEM were essentially those of the OMNIBUS-85 Study, with the addition of ammunition "add-on factors" for both sides. The other inputs to FASTALS were those of the OMNIBUS-84 Study. The results of FASTALS were compared with OMNIBUS-84 FASTALS results based on a 180-day CEM simulation. The comparison of the FASTALS results of CEM and FORCEM is documented in a separate memorandum, Reference 3.

b. The operational test illuminated an important feature of the FORCEM-FASTALS interface, namely, that FASTALS is highly sensitive to the length of the theater combat simulation. That is, a FASTALS roundout of a 30-day simulation produces significantly smaller requirements for support units than a roundout of a 180-day simulation. This is partly because the 180-day roundout of a 30-day simulation assumes no attrition nor ammunition expenditures after D+30 and assumes all divisions to be in the "reserve" intensity level after D+30. And it is partly because FASTALS reports the support units required not to meet the peak requirement (which may occur before D+30) but to meet the average requirement from the peak through D+180. Consequently, if FORCEM-FASTALS results are to be at all comparable to the FASTALS results of earlier studies, FORCEM must simulate the same number of days of combat.

c. Several factors, unfortunately, limit the value of this FORCEM-CEM comparison of FASTALS results. First, there are recognized shortcomings in the OMNIBUS-85 FORCEM simulation, such as the very low expenditure of artillery ammunition, that can significantly affect FASTALS results. Second, there are differences between OMNIBUS-84 and OMNIBUS-85 in the schedule of deployment of Blue and Red forces, in the modernization (causing large changes in quantities) of weapons of both sides, in scenario assumptions, and in the Combat Sample Generator (COSAGE) used for attrition calibration (so that the effectiveness of each weapon in division engagements differs between OMNIBUS-84 CEM and OMNIBUS-85 FORCEM). As a consequence of such differences, the CEM and FORCEM simulations are markedly different. For example, there is generally a significantly smaller percentage of the US forces in active engagements (attacking or attacked) in the FORCEM than in the CEM simulation (see Figure 1 of Reference 3). Be that as it may, this is the only source of FORCEM results available at the time of the POSTFOR Study, and OMNIBUS-84 is the most nearly comparable study with FASTALS results for comparison.

2-8. SUMMARY. This chapter has described the four computer routines developed to link FORCEM to FASTALS, has provided instructions for using these routines, and has explained the operational testing of the FORCEM-FASTALS linkage that was conducted in the POSTFOR Study.

CHAPTER 3

ADDCOP GRAPHICS

3-1. INTRODUCTION. This chapter describes several computer routines designed and implemented during the course of the POSTFOR Study to link FORCEM to the ADDCOP graphics processor.

a. The ADDCOP processor, which was developed as a postprocessor to CEM, permits campaign simulation results to be displayed graphically, either by convenient batch jobs on the CALCOMP plotter or by the Superset PGM devices (ADDCOP is documented in Appendix E). ADDCOP also offers the capability to display graphic comparisons of the results of as many as five different campaign simulations, thus exhibiting the sensitivity of FORCEM results to variations in FORCEM inputs or study assumptions.

b. Essentially, the routines documented here and developed by the POSTFOR Study provide an interface between FORCEM and ADDCOP by reading FORCEM output files, which are described in Appendix D, and writing files in the format required by ADDCOP. Also, a utility routine was developed to remove from the resulting ADDCOP input files a specified number of campaign simulation cycles at the beginning or end of a simulation.

3-2. CAMPAIGN SUMMARY. The first FORCEM-ADDCOP interface program, SUMAC, constructs a campaign summary file, similar to the ADDCOP summary file generated by CEM, so that simulations with different durations or different D-days can be graphed on the same time scale.

a. This file contains simulation data concerning nondivisional artillery, tactical aircraft, FEBA displacement, average division states, frequencies of engagement types, and losses of tanks, personnel, and ammunition. A "menu" of the data that can be selected from this file for graphing is shown in Figure 3-1. As noted in paragraph 2-3, the term "FEBA displacement" is actually a misnomer when applied to FORCEM results; menu items 9 and 10 contain the average (across Blue Army headquarters) distance that the Army objective phase line is forward of the most forward division in the online subordinate corps, from the FORCEM Command and Control (R41) Report. The "average state" is given by

$$\text{state} = 100 \times \text{OHCW/AUCW},$$

where OHCW is the sum across all divisions of onhand combat worth, and AUCW is the sum across all divisions of authorized combat worth, from the FORCEM Division Equipment (R51) Report. Data in this summary file are recorded at daily intervals.

```
 1:BLUE DIV ARTY ON HAND
 2:AVERAGE STATE BLUE
 3:BLUE DIV IN THEATER
 4:BLUE NON-DIV ARTY IN GS
 5:AVERAGE STATE RED
 6:RED DIV IN THEATER
 7:RED DIV ARTY ON HAND
 8:RED NON-DIV ARTY IN GS
 9:AVG FEBA CHANGE/DAY
10:AVG NET FEBA CHANGE
11:BLUE TAC AIR IN THEATER
12:BLUE CAS AIRCRAFT
13:BLUE AMMO SPENT/DAY
14:BLUE CUM AMMO SPENT
15:RED TAC AIR IN THEATER
16:RED CAS AIRCRAFT
17:RED AMMO SPENT/DAY
18:RED CUM AMMO SPENT
19:B PERM TANK LOSS(CUM)
20:R PERM TANK LOSS(CUM)
21:B PERM PERSNL LOSS/DAY
22:B PERM PERS LOSS(CUM)
23:BLUE NON-DIV ARTY IN DS
24:RED NON-DIV ARTY IN DS
25:PCT B ATTACK, R DEFEND
26:PCT B ATTACK, R DELAY
27:PCT B DEFEND, R ATTACK
28:PCT B DELAY, R ATTACK
29:PCT BLUE STATIC
30:PCT B MOVING, NOT ENGAGD
31:PCT B NOT MOVG OR ENGAGD
32:BLUE OFFENSIVE COUNTERAIR
33:RED OFFENSIVE COUNTERAIR
34:PCT BLUE ATTACKING
35:PCT B ATTACKED BY RED
36:PCT US ATTACK, R DEFEND
37:PCT US ATTACK, R DELAY
38:PCT US DEFEND, R ATTACK
39:PCT US DELAY, R ATTACK
40:PCT US STATIC
41:PCT US MOVNG, NOT ENGAGD
42:US NOT MOVING OR ENGAGED
43:BLUE DEFENSIVE COUNTERAIR
44:RED DEFENSIVE COUNTERAIR
45:PCT US ATTACKING
46:PCT US ATTACKED BY RED
47:PCT NONUS ATK, R DEFEND
48:PCT NONUS ATK, R DELAY
49:PCT NONUS DEFEND, R ATK
50:PCT NONUS DELAY, R ATK
51:PCT NONUS STATIC
52:NONUS MOVING, NOT ENGAGD
53:NONUS NOT MOVG OR ENGAGD
54:BLUE DEEP INTERDICTION
55:RED DEEP INTERDICTION
56:PCT NONUS ATTACKING
57:NONUS ATTACKED BY RED
58:PCT R DEFEND, B ATTACK
59:PCT R DELAY, B ATTACK
60:PCT R ATTACK, B DEFEND
61:PCT R ATTACK, B DELAY
62:PCT RED STATIC
63:PCT R MOVING, NOT ENGAGD
64:PCT R NOT MOVG OR ENGAGD
65:BLUE NUC-CHEM AIRCRAFT
66:RED NUC-CHEM AIRCRAFT
67:PCT R ATTACKED BY BLUE
68:PCT RED ATTACKING
69:PCT BLUE FORCE IN THTR
70:PCT RED FORCE IN THTR
```

Figure 3-1. Campaign Summary ADDCOP Menu

b. A sample runstream for the SUMAC program is given in Figure 3-2. This SUMAC program reads FEBA displacement and counts of Blue and Red divisions from the FORCEM R41 Report (unit 21); Blue and Red tactical aircraft status from the Air Allocation (R42) Report (unit 22); Blue and Red authorized and onhand combat worth from R51 (unit 15); status of Blue and Red nondivisional artillery from the Artillery Allocation (R61) Report (unit 28); consumption of ammunition and losses of tanks and personnel from R64 (unit 24); and engagement frequencies from the Engagement Frequency (R66) Report (unit 26). It also reads a summary skeleton (titles) file from unit 11. The resulting campaign summary ADDCOP input file, in the format described at page E-5, is written to file 9, which can be saved by the user. One input data record is read by the program from the system input stream (file 5). This data record (line 20 of Figure 3-2) contains, in columns 1-3, right justified, the number of days simulated; and in columns 4-75, an optional run title. The number of days simulated cannot exceed 200. Note that only the first 22 lines of the runstream in Figure 3-2 are used to execute SUMAC. The remaining 35 lines of the runstream demonstrate how the ADDCOP processor might be used to plot the results, as described in Appendix E.

```
 1:@FREE 9.
 2:@FREE 11.
 3:@ASG,A 17-072120R41.
 4:@USE 21.,17-07212CR41.
 5:@ASG,A 17-072120R42.
 6:@USE 22.,17-07212CR42.
 7:@ASG,A 17-072120R51.
 8:@USE 15.,17-07212CR51.
 9:@USE 28.,17-07212CR61.
10:@ASG,A 17-072120R61.
11:@ASG,A 17-072120R64.
12:@USE 24.,17-07212CR64.
13:@ASG,A 17-072120R66.
14:@USE 26.,17-072120R66.
15:@ASG,T 11.
16:@USE P.,71PFOP.
17:@ED P.SUMSKL,11.
18:@ASG,T 9.
19:@XQT P.385SUMAC
20:024   OMNIBUS-84 TEST 21JUL85  --UNCLASSIFIED--
21:@ED 9.,J8ADDCOP.SUM/21JUL
22:EXI
23:@FREE 21.
24:@FREE 15.
25:@FREE 24.
26:@FREE 22.
27:@FREE 28.
28:@FREE 26.
29:@FREE 11.
30:@ASG,A G7CEM.
31:@G7CEM.ADDCOC,CBMZ 9.
32:'FORCEM  OMN-84,  21JUL '   2 1,2 1,5
33:'FORCEM  OMN-84,  21JUL '   2 1,3 1,6
34:'FORCEM  OMN-84,  21JUL '   2 1,1 1,7
35:'FORCEM  OMN-84,  21JUL '   2 1,11 1,15
36:'FORCEM  OMN-84,  21JUL '   2 1,12 1,16
37:'FORCEM  OMN-84,  21JUL '   2 1,13 1,17
38:'FORCEM  OMN-84,  21JUL '   2 1,14 1,18
39:'FORCEM  OMN-84,  21JUL '   1 1,9
40:'FORCEM  OMN-84,  21JUL '   1 1,10
41:'FORCEM  OMN-84,  21JUL '   2 1,19 1,20
42:'FORCEM  OMN-84,  21JUL '   1 1,21
43:'FORCEM  OMN-84,  21JUL '   1 1,22
44:'FORCEM  OMN-84,  21JUL '   5 1,25 1,26 1,27 1,28 1,29
45:'FORCEM  OMN-84,  21JUL '   4 1,4 1,8 1,23 1,24
46:'FORCEM  OMN-84,  21JUL '   4 1,32 1,33 1,43 1,44
47:'FORCEM  OMN-84,  21JUL '   4 1,54 1,55 1,65 1,66
48:'FORCEM  OMN-84,  21JUL '   4 1,30 1,31 1,34 1,35
49:'FORCEM  OMN-84,  21JUL '   5 1,36 1,37 1,38 1,39 1,40
50:'FORCEM  OMN-84,  21JUL '   4 1,41 1,42 1,45 1,46
51:'FORCEM  OMN-84,  21JUL '   5 1,47 1,48 1,49 1,50 1,51
52:'FORCEM  OMN-84,  21JUL '   4 1,52 1,53 1,56 1,57
53:'FORCEM  OMN-84,  21JUL '   5 1,58 1,59 1,60 1,61 1,62
54:'FORCEM  OMN-84,  21JUL '   4 1,63 1,64 1,67 1,68
55:'FORCEM  OMN-84,  21JUL '   2 1,69 1,70
56:@EOF
57:@SYM,U PLOTS,,PLOTOI
```

Figure 3-2. Sample Campaign Summary ADDCOP Runstream

3-3. LOGISTICS STATUS. The second ADDCOP interface program, LOGAC, constructs three ADDCOP input files, similar to the BLUELOG, REDLOG, and BLUELOGPART ADDCOP files generated by CEM, which contain the status, resupply, repairs, consumption and losses of personnel, equipment, and supplies.

a. Data are recorded at 1-day intervals for personnel, fuel (POL), tank ammunition, other supplies, tanks, light armor (APC), helicopters, antitank/mortars (AT/M), artillery, artillery ammunition, and other ammunition, as shown in the menus in Figures 3-3, 3-4, and 3-5. The partitioned Blue log file distinguishes between US and non-US allied nations for personnel, POL, ammunition, and other supplies. The criterion for national partition (that is, US or non-US allied) of ammunition is the fourth, rather than the second, field of the record in the FORCEM R64 Report. For personnel and supplies other than ammunition, the second field of the R64 records is used for the national partition. Onhand assets include the contents of replacement pools and support complexes, as well as of combat units. Authorized assets may include FORCEM support complexes, but do not include pools. "Total gains" is the sum of arriving replacements plus returns from repair.

```
 1:BLUE PERS AUTHORIZED
 2:BLUE PERS ON HAND
 3:B PERS RESUPPLY(CUM)
 4:B PERS FROM HOSPITAL
 5:BLUE PERS TOTAL GAINS
 6:BLUE PERS IN HOSPITAL
 7:BLUE PERS KILLED (CUM)
 8:B PERS WOUNDED (CUM)
 9:B PERS CASUALTIES (CUM)
10:BLUE DNBI (CUM)
11:BLUE POL AUTHORIZED
12:BLUE POL ON HAND
13:B POL RESUPPLY(CUM)
14:B POL CONSUMED (CUM)
15:BLUE POL CONSUMED/DAY
16:B TANK AMMO S/T AUTHRIZD
17:B TANK AMMO S/T ON HAND
18:B TANK AM RESUPPLY (CUM)
19:B TANK AMMO SPENT (CUM)
20:B TNK AMMO S/T SPENT/DAY
21:B SPECIAL AMMO STON AUTH
22:BLU SP AMMO STON ON HAND
23:B SP AMMO CUM RESUPPLY
24:B SP AMMO SPENT, CUM TON
25:B SPECIAL AMMO STON/DAY
26:BLUE TANKS AUTHORIZED
27:BLUE TANKS ON HAND
28:B TANK RESUPPLY(CUM)
29:B TANKS FROM REPAIR
30:B TANKS TOTAL GAINS
31:BLUE TANKS IN REPAIR
32:B TANKS PERM LOSS/DAY
33:B TANKS PERM LOSS(CUM)
34:BLUE TANKS LOST/DAY
35:B TANKS TEMP LOSS/DAY
36:BLUE APC AUTHORIZED
37:BLUE APC ON HAND
38:B APC RESUPPLY(CUM)
39:BLUE APC FROM REPAIR
40:BLUE APC TOTAL GAINS
41:BLUE APC IN REPAIR
42:B APC PERM LOSS/DAY
43:B APC PERM LOSS(CUM)
44:BLUE APC LOST/DAY
45:B APC TEMP LOSS/DAY
46:BLUE HELO AUTHORIZED
47:BLUE HELO ON HAND
48:B HELO RESUPPLY(CUM)
49:BLUE HELO FROM REPAIR
50:BLUE HELO TOTAL GAINS
51:BLUE HELO IN REPAIR
52:B HELO PERM LOSS/DAY
53:B HELO PERM LOSS(CUM)
54:BLUE HELO LOST/DAY
55:B HELO TEMP LOSS/DAY
56:BLUE AT/M AUTHORIZED
57:BLUE AT/M ON HAND
58:B AT/M RESUPPLY(CUM)
59:BLUE AT/M FROM REPAIR
60:BLUE AT/M TOTAL GAINS
61:BLUE AT/M IN REPAIR
62:B AT/M PERM LOSS/DAY
63:B AT/M PERM LOSS(CUM)
64:BLUE AT/M LOST/DAY
65:B AT/M TEMP LOSS/DAY
66:BLUE ARTY AUTHORIZED
67:BLUE ARTY ON HAND
68:B ARTY RESUPPLY(CUM)
69:BLUE ARTY FROM REPAIR
70:BLUE ARTY TUBE GAINS
71:BLUE ARTY IN REPAIR
72:B ARTY PERM LOSS/DAY
73:B ARTY PERM LOSS(CUM)
74:B ARTY TUBES LOST/DAY
75:B ARTY TEMP LOSS/DAY
76:B ARTY AM S/T AUTHORIZED
77:B ARTY AMMO S/T ON HAND
78:B ARTY AM RESUPPLY (CUM)
79:B ARTY AMMO SPENT (CUM)
80:B ARTY AMMO SPENT/DAY
81:B OTHER AMMO S/T AUTHRZD
82:B OTHER AMMO S/T ON HAND
83:B OTHER AM RESUPPLY(CUM)
84:B OTHER AMMO SPENT (CUM)
85:B OTHER AMMO SPENT/DAY
86:B PERS CMIA (CUM)
87:B PATIENTS EVAC (CUM)
88:B PCT RTD FROM HOSPTL
```

Figure 3-3. Blue Log ADDCOP Menu

```
 1:RED  PERS AUTHORIZED
 2:RED  PERS ON HAND
 3:R PERS RESUPPLY(CUM)
 4:R PERS FROM HOSPITAL
 5:RED  PERS TOTAL GAINS
 6:RED  PERS IN HOSPITAL
 7:RED  PERS KILLED (CUM)
 8:R PERS WOUNDED (CUM)
 9:R PERS CASUALTIES (CUM)
10:RED  DNBI (CUM)
11:RED  POL AUTHORIZED
12:RED  POL ON HAND
13:R POL RESUPPLY(CUM)
14:R POL CONSUMED (CUM)
15:RED  POL CONSUMED/DAY
16:R TANK AMMO S/T AUTHRIZD
17:R TANK AMMO S/T ON HAND
18:R TANK AM RESUPPLY (CUM)
19:R TANK AMMO SPENT (CUM)
20:R TNK AMMO S/T SPENT/DAY
21:R SPECIAL AMMO STON AUTH
22:RED SP AMMO STON ON HAND
23:R SP AMMO CUM RESUPPLY
24:R SP AMMO SPENT, CUM TON
25:R SPECIAL AMMO STON/DAY
26:RED  TANKS AUTHORIZED
27:RED  TANKS ON HAND
28:R TANK RESUPPLY(CUM)
29:R TANKS FROM REPAIR
30:R TANKS TOTAL GAINS
31:RED  TANKS IN REPAIR
32:R TANKS PERM LOSS/DAY
33:R TANKS PERM LOSS(CUM)
34:RED  TANKS LOST/DAY
35:R TANKS TEMP LOSS/DAY
36:RED  APC AUTHORIZED
37:RED  APC ON HAND
38:R APC RESUPPLY(CUM)
39:RED  APC FROM REPAIR
40:RED  APC TOTAL GAINS
41:RED  APC IN REPAIR
42:R APC PERM LOSS/DAY
43:R APC PERM LOSS(CUM)
44:RED  APC LOST/DAY
45:R APC TEMP LOSS/DAY
46:RED  HELO AUTHORIZED
47:RED  HELO ON HAND
48:R HELO RESUPPLY(CUM)
49:RED  HELO FROM REPAIR
50:RED  HELO TOTAL GAINS
51:RED  HELO IN REPAIR
52:R HELO PERM LOSS/DAY
53:R HELO PERM LOSS(CUM)
54:RED  HELO LOST/DAY
55:R HELO TEMP LOSS/DAY
56:RED  AT/M AUTHORIZED
57:RED  AT/M ON HAND
58:R AT/M RESUPPLY(CUM)
59:RED  AT/M FROM REPAIR
60:RED  AT/M TOTAL GAINS
61:RED  AT/M IN REPAIR
62:R AT/M PERM LOSS/DAY
63:R AT/M PERM LOSS(CUM)
64:RED  AT/M LOST/DAY
65:R AT/M TEMP LOSS/DAY
66:RED  ARTY AUTHORIZED
67:RED  ARTY ON HAND
68:R ARTY RESUPPLY(CUM)
69:RED  ARTY FROM REPAIR
70:RED  ARTY TUBE GAINS
71:RED  ARTY IN REPAIR
72:R ARTY PERM LOSS/DAY
73:R ARTY PERM LOSS(CUM)
74:R ARTY TUBES LOST/DAY
75:R ARTY TEMP LOSS/DAY
76:R ARTY AM S/T AUTHORIZED
77:R ARTY AMMO S/T ON HAND
78:R ARTY AM RESUPPLY (CUM)
79:R ARTY AMMO SPENT (CUM)
80:R ARTY AMMO SPENT/DAY
81:R OTHER AMMO S/T AUTHRZD
82:R OTHER AMMO S/T ON HAND
83:R OTHER AM RESUPPLY(CUM)
84:R OTHER AMMO SPENT (CUM)
85:R OTHER AMMO SPENT/DAY
86:R PERS CMIA (CUM)
87:R PATIENTS EVAC (CUM)
88:R PCT RTD FROM HOSPTL
```

Figure 3-4. Red Log ADDCOP Menu

```
 1:US PERSONNEL AUTHORIZED
 2:US PERSONNEL ON HAND
 3:US PERSONNEL CMIA (CUM)
 4:US PERS FROM HOSPITAL
 5:US PATIENTS EVAC (CUM)
 6:US PERSONNEL IN HOSPITAL
 7:US PERS KILLED (CUM)
 8:US PERS WOUNDED (CUM)
 9:US PERS CASUALTIES (CUM)
10:US PERS D N B I (CUM)
11:NUSN PERS AUTHORIZED
12:NUSN PERSONNEL ON HAND
13:NUSN PERS CMIA (CUM)
14:NUSN PERS FROM HOSPITAL
15:NUSN PATIENTS EVAC (CUM)
16:NUSN PERS IN HOSPITAL
17:NUSN PERS KILLED (CUM)
18:NUSN PERS WOUNDED (CUM)
19:NUSN PERS CASUALTIES
20:NUSN PERS D N B I (CUM)
21:US OTHER AM AUTHORIZED
22:US OTHER AM ON HAND
23:NOT USED
24:US OTHER AM SPENT (CUM)
25:US OTHER AM SPENT/DAY
26:NUSN OTHER AM AUTHORIZED
27:NUSN OTHER AM ON HAND
28:NOT USED
29:NUSN OTHER AM SPENT(CUM)
30:NUSN OTHER AM SPENT/DAY
31:US POL AUTHORIZED
32:US POL ON HAND
33:NOT USED
34:US POL CONSUMED (CUM)
35:US POL CONSUMED/DAY
36:NUSN POL AUTHORIZED
37:NUSN POL ON HAND
38:NOT USED
39:NUSN POL CONSUMED (CUM)
40:NUSN POL CONSUMED/DAY
41:NOT USED
42:NOT USED
43:NOT USED
44:NOT USED
45:NOT USED
46:US TANK AMMO AUTHORIZED
47:US TANK AMMO ON HAND
48:NOT USED
49:US TANK AMMO SPENT (CUM)
50:US TANK AMMO SPENT/DAY
51:NUSN TANK AM AUTHORIZED
52:NUSN TANK AM ON HAND
53:NOT USED
54:NUSN TANK AM SPENT (CUM)
55:NUSN TANK AM SPENT/DAY
56:NOT USED
57:NOT USED
58:NOT USED
59:NOT USED
60:NOT USED
61:US SPECL AMMO STON AUTH
62:US SP AMMO STON ON HAND
63:US SP AMMO CUM RESUPPLY
64:US SP AMMO CONSUMED, CUM
65:US SPECIAL AMMO STON/DAY
66:NUSN SPCL AMMO STON AUTH
67:NUSN SP AMMO TON ON HAND
68:NUSN SPCL AMMO RESUPPLY
69:NUSN SP AMMO STON SPENT
70:NUSN SPCL AMMO STON/DAY
71:NOT USED
72:NOT USED
73:NOT USED
74:NOT USED
75:NOT USED
76:US ARTY AM AUTHORIZED
77:US ARTY AM ON HAND
78:NOT USED
79:US ARTY AM SPENT (CUM)
80:US ARTY AM SPENT/DAY
81:NUSN ARTY AM AUTHORIZED
82:NUSN ARTY AM ON HAND
83:NOT USED
84:NUSN ARTY AM SPENT (CUM)
85:NUSN ARTY AM SPENT/DAY
```

Figure 3-5. Partitioned Blue Log ADDCOP Menu

b. A sample runstream for the LOGAC program is given in Figure 3-6. This LOGAC program reads the FORCEM Loss and Consumption Report (R64) from unit 24, the FORCEM resupply input file from unit 15, and ADDCOP Blue Log, Red Log and Partitioned Blue Log skeletons from units 11, 12, and 13, respectively. The resulting Blue Log, Red Log, and Partitioned Blue Log ADDCOP input files, formatted according to page E-5, are written to units 8, 9, and 10, respectively, which may be stored by the user. The LOGAC program reads one data record from the system input stream (unit 5). This data record (line 23 of Figure 3-6) contains, in columns 1-3, right justified, the number of days simulated, which cannot exceed 200; and in columns 4-75 an optional run title. Only the first 29 lines of the runstream in Figure 3-6 are used to execute LOGAC. The remaining 35 lines of the runstream show how the ADDCOP processor might be used to plot the results, as described in Appendix E.

c. A feature of the LOGAC program is that if FORCEM asset numbers are changed between FORCEM runs, no changes are necessary in the LOGAC FORTRAN code or inputs. The asset categories of the resupply inputs are read from the R64 Report.

```
 1:@FREE 15.
 2:@FREE 11.
 3:@FREE 12.
 4:@FREE 13.
 5:@FREE  8.
 6:@FREE  9.
 7:@FREE 10.
 8:@ASG,T 15.
 9:@ED 12INPUTX.RESUPPLY/NEW,15.
10:@ASG,A 17-07212OR64.
11:@USE 24.,17-072120R64.
12:@ASG,T 11.
13:@ASG,T 12.
14:@ASG,T 13.
15:@USE P.,71PFOR.
16:@ED P.BLOGSKL,11.
17:@ED P.RLOGSKL,12.
18:@ED P.BLPSKL,13.
19:@ASG,T 9.
20:@ASG,T 8.
21:@ASG,T 10.
22:@XQT P.385LOGAC
23:025  OMN1BUS-84 TEST 21JUL85  --UNCLASSIFIED--
24:@ED 8.,J8ADDCOP.BLOG/21JUL
25:EXI
26:@ED 9.,J8ADDCOP.RLOG/21JUL
27:EXI
28:@ED 10.,J8ADDCOP.BLOGPT/21JUL
29:EXI
30:@FREE 24.
31:@FREE 11.
32:@FREE 12.
33:@FREE 13.
34:@FREE 15.
35:@ASG,A G7CEM.
36:@G7CEM.ADDCOC,CBZM 8.,9.,10.
37:*FORCEM  OMN-84,  21  JUL*   4 1,1 2,1  1,2 2,2
38:*FORCEM  OMN-84,  21  JUL*   4 3,1 3,2  3,11  3,12
39:*FORCEM  OMN-84,  21  JUL*   4 1,6 2,6  3,6  3,16
40:*FORCEM  OMN-84,  21  JUL*   4 1,4 2,4  3,4  3,14
41:*FORCEM  OMN-84,  21  JUL*   4 1,3 2,3  1,13 2,13
42:*FORCEM  OMN-84,  21  JUL*   4 1,83  2,83 1,23 2,23
43:*FORCEM  OMN-84,  21  JUL*   4 1,7 2,7  3,7  3,17
44:*FORCEM  OMN-84,  21  JUL*   4 1,9 2,9  3,9  3,19
45:*FORCEM  OMN-84,  21  JUL*   4 1,10  2,10 3,10 3,20
46:*FORCEM  OMN-84,  21  JUL*   4 1,8 2,8  3,8  3,18
47:*FORCEM  OMN-84,  21  JUL*   4 1,86  2,86 3,3  3,13
48:*FORCEM  OMN-84,  21  JUL*   4 1,87  2,87 3,5  3,15
49:*FORCEM  OMN-84,  21  JUL*   4 1,76  2,76 3,76 3,81
50:*FORCEM  OMN-84,  21  JUL*   4 1,77  2,77 3,77 3,82
51:*FORCEM  OMN-84,  21  JUL*   4 1,78  2,78 1,10 2,18
52:*FORCEM  OMN-84,  21  JUL*   4 1,80  2,80 3,80 3,85
53:*FORCEM  OMN-84,  21  JUL*   4 1,16  2,16 3,46 3,51
54:*FORCEM  OMN-84,  21  JUL*   4 1,17  2,17 3,47 3,52
55:*FORCEM  OMN-84,  21  JUL*   4 1,20  2,20 3,50 3,55
56:*FORCEM  OMN-84,  21  JUL*   4 1,19  2,19 3,49 3,54
57:*FORCEM  OMN-84,  21  JUL*   4 1,84  2,84 3,24 3,29
58:*FORCEM  OMN-84,  21  JUL*   4 1,18  2,18 1,83 2,83
59:*FORCEM  OMN-84,  21  JUL*   4 1,81  2,81 3,21 3,26
60:*FORCEM  OMN-84,  21  JUL*   4 1,82  2,82 3,22 3,27
61:*FORCEM  OMN-84,  21  JUL*   4 1,85  2,85 3,25 3,30
62:*FORCEM  OMN-84,  21  JUL*   2 1,88  2,88
63:@EOF
64:@SYM,U PLOT3,,PLOT01
```

Figure 3-6. Sample Log Status ADDCOP Runstream

3-4. STATUS OF DIVISIONS. A third FORCEM-ADDCOP interface program, DIVOH, has been developed by the POSTFOR Study to convert several of the FORCEM reports concerning the status and onhand assets of the Blue and Red divisions played in FORCEM into the format required by the ADDCOP graphics processor.

a. This program permits the user to select a single division, a list of (as many as 100) divisions, or a list of (as many as 20) corps whose division onhand assets are to be displayed as a function of simulation time. The results are stored in an ADDCOP-compatible file, in the format described at page E-5, in 12-hour time intervals, the shortest time period currently available from FORCEM. The data are read from FORCEM reports at the end of each cycle, after combat and resupply. The menu of parameters that can be displayed is shown in Figure 3-7.

```
 1:FORCE RATIO
 2:ENGAGED FORCE RATIO
 3:DIVISION STATE (PCT)
 4:TYPE 1 TANKS ON HAND
 5:TYPE 2 TANKS ON HAND
 6:TYPE 3 TANKS ON HAND
 7:TYPE 4 TANKS ON HAND
 8:TYPE 5 TANKS ON HAND
 9:TYPE 6 TANKS ON HAND
10:TYPE 7 TANKS ON HAND
11:TYPE 8 TANKS ON HAND
12:TYPE 9 TANKS ON HAND
13:TYPE 10 TANKS ON HAND
14:TYPE 11 TANKS ON HAND
15:TYPE 12 TANKS ON HAND
16:TYPE 1 APCS ON HAND
17:TYPE 2 APCS ON HAND
18:TYPE 3 APCS ON HAND
19:TYPE 4 APCS ON HAND
20:TYPE 5 APCS ON HAND
21:TYPE 6 APCS ON HAND
22:TYPE 7 APCS ON HAND
23:TYPE 8 APCS ON HAND
24:TYPE 9 APCS ON HAND
25:TYPE 10 APCS ON HAND
26:TYPE 11 APCS ON HAND
27:TYPE 12 APCS ON HAND
28:TYPE 1 HELO ON HAND
29:TYPE 2 HELO ON HAND
30:TYPE 3 HELO ON HAND
31:TYPE 4 HELO ON HAND
32:TYPE 5 HELO ON HAND
33:TYPE 1 AT/M ON HAND
34:TYPE 2 AT/M ON HAND
35:TYPE 3 AT/M ON HAND
36:TYPE 4 AT/M ON HAND
37:TYPE 5 AT/M ON HAND
38:TYPE 6 AT/M ON HAND
39:TYPE 7 AT/M ON HAND
40:TYPE 8 AT/M ON HAND
41:TYPE 9 AT/M ON HAND
42:TYPE 10 AT/M ON HAND
43:TYPE 11 AT/M ON HAND
44:TYPE 12 AT/M ON HAND
45:TYPE 1 ARTILLERY ON HAND
46:TYPE 2 ARTILLERY ON HAND
47:TYPE 3 ARTILLERY ON HAND
48:TYPE 4 ARTILLERY ON HAND
49:TYPE 5 ARTILLERY ON HAND
50:TYPE 6 ARTILLERY ON HAND
51:TYPE 7 ARTILLERY ON HAND
52:TYPE 8 ARTILLERY ON HAND
53:WPNS CREW PERS ON HAND
54:WPNS CREW PCT ON HAND
55:INFANTRY PERS ON HAND
56:INFANTRY PCT ON HAND
57:HELO CREW PERS ON HAND
58:HELO CREW PCT ON HAND
59:OTHER DIV PERS ON HAND
60:OTHER PERS PCT ON HAND
61:TOTAL DIV PERS ON HAND
62:TOTAL PERS PCT ON HAND
63:TANK AMMO ON HAND
64:TANK AMMO PCT ON HAND
65:ARTY AMMO ON HAND
66:ARTY AMMO PCT ON HAND
67:SPECIAL AMMO ON HAND
68:SPECIAL AMMO PCT ON HAND
69:OTHER AMMO ON HAND
70:OTHER AMMO PCT ON HAND
71:TOTAL AMMO ON HAND
72:TOTAL AMMO PCT ON HAND
73:FUEL ON HAND
74:FUEL PER CENT ON HAND
75:SPARE PARTS ON HAND
76:SPARE PARTS PCT ON HAND
77:TANKS ON HAND
78:TANKS PER CENT ON HAND
79:APCS ON HAND
80:APCS PER CENT ON HAND
81:HELICOPTERS ON HAND
82:HELO PER CENT ON HAND
83:AT/M ON HAND
84:AT/M PER CENT ON HAND
85:ARTILLERY ON HAND
86:ARTILLERY PCT ON HAND
```

Figure 3-7. Division Onhand Assets ADDCOP Menu

b. The DIVOH program reads data from the FORCEM Combat Headquarters Report - Part 3 (R30, R31, R32, R44, R45), Command and Control Report (R41), Division Personnel, Supply, and Equipment Reports (R49, R50, R51), and from an ADDCOP skeleton (titles) file. The resulting ADDCOP-compatible file is written to unit 9, which may be stored by the user. A sample runstream for this DIVOH program is given in Figure 3-8. The program reads from the system input stream (unit 5) one record (line 26 of Figure 3-8) containing, in columns 1-3, right-justified, the number of 12-hour cycles simulated and in columns 4-75 an optional title, followed by a record (lines 27-29 of Figure 3-8) for each division or corps selected, containing the FORCEM unit identification number beginning in column 1. This runstream requests that data be read for divisions 1101 and 1102, and for all the divisions in corps 2200. Only the first 32 lines of the sample runstream in Figure 3-8 are used to run the DIVOH program. The rest of the runstream demonstrates how the ADDCOP processor might be used to plot certain results, as described in Appendix E. A limitation of the ADDCOP processor is that the number of 12-hour cycles read cannot exceed 300.

```
 1:@FREE 8.
 2:@FREE 9.
 3:@ASG,A 17-072120R41.
 4:@USE 11.,17-072120R41.
 5:@ASG,A 17-072120R30.
 6:@USE 30.,17-072120R30.
 7:@ASG,A 17-072120R31.
 8:@USE 13.,17-072120R31.
 9:@ASG,A 17-072120R32.
10:@USE 12.,17-072120R32.
11:@ASG,A 17-072120R44.
12:@USE 14.,17-072120R44.
13:@ASG,A 17-072120R45.
14:@USE 15.,17-072120R45.
15:@ASG,A 17-072120R49.
16:@USE 19.,17-072120R49.
17:@ASG,A 17-072120R50.
18:@USE 20.,17-072120R50.
19:@ASG,A 17-072120R51.
20:@USE 21.,17-072120R51.
21:@ASG,T 8.
22:@USE P.,7IPFCR.
23:@ED P.DYOHSKL,8.
24:@ASG,T 9.
25:@XQT P.385DIVCH
26:049  OMNIBUS-85 TEST 21JUL85
27:1101
28:1102
29:2200
30:@EOF
31:@ED 9.,J8ADDCOP.DIVOH/21JUL
32:EXI
33:@FREE 21.
34:@FREE 20.
35:@FREE 19.
36:@FREE 30.
37:@FREE 13.
38:@FREE 12.
39:@FREE 11.
40:@FREE 14.
41:@FREE 15.
42:@FREE 8.
43:@ASG,A G7CEM.
44:@G7CEM.ADDCOC,CBM 9.
45:*FORCEM OM-84, 21JUL*  2 1,2 1,1
46:*FORCEM OM-84, 21JUL*  5 1,4 1,5 1,6 1,7 1,8 1,9
47:*FORCEM OM-84, 21JUL*  5 1,17 1,18 1,19 1,20 1,21
48:*FORCEM OM-84, 21JUL*  5 1,28 1,29 1,30 1,31 1,32
49:*FORCEM OM-84, 21JUL*  5 1,33 1,34 1,35 1,36 1,37
50:*FORCEM OM-84, 21JUL*  5 1,45 1,46 1,47 1,48 1,49
51:*FORCEM OM-84, 21JUL*  5 1,53 1,55 1,57 1,59 1,61
52:*FORCEM OM-84, 21JUL*  5 1,54 1,56 1,58 1,60 1,62
53:*FORCEM OM-84, 21JUL*  5 1,63 1,65 1,67 1,69 1,71
54:*FORCEM OM-84, 21JUL*  5 1,64 1,66 1,68 1,70 1,72
55:*FORCEM OM-84, 21JUL*  5 1,77 1,79 1,81 1,83 1,85
56:*FORCEM OM-84, 21JUL*  5 1,78 1,80 1,82 1,84 1,86
57:*FORCEM OM-84, 21JUL*  2 1,73 1,75
58:*FORCEM OM-84, 21JUL*  3 1,3 1,74 1,76
59:@EOF
60:@SYM,U PLOTS,,PLOT01
```

Figure 3-8. Sample Division Onhand Assets ADDCOP Runstream

3-5. ADDCOP FILE MANIPULATOR. Another ADDCOP auxiliary program was developed by the POSTFOR Study to reduce an ADDCOP file prior to plotting by deleting a specified number of cycles (such as days) of data from the beginning and end of a simulation.

a. This program, ADJDAY, is useful if results of a longer simulation are to be plotted by the ADDCOP processor in comparison with data from a shorter simulation; but the principal purpose of ADJDAY is to delete data of days simulated prior to D-day, so that plots can show results from D-day onward.

b. The ADJDAY program reads the ADDCOP file to be modified from unit 11, and writes the resulting ADDCOP-compatible file to unit 9, which may be stored by the user. A sample runstream, which deletes 10 cycles of data from the beginning of a simulation and retains the next 20 cycles, is shown in Figure 3-9. One input record (line 8 of Figure 3-9) is read from the system input stream, containing the number of cycles (days) of data to be deleted at the beginning of the simulation and the number of cycles (days) of data to retain in the resulting ADDCOP file. A limitation is that the input file cannot contain more than 200 cycles of data.

```
 1:@FREE 9.
 2:@FREE 11.
 3:@ASG,T 11.
 4:@USE P.,71PFCR.
 5:@ED J8ADDCOP.BLOG/21JUL,11.
 6:@ASG,T 9.
 7:@XQT P.36SADJDAY
 8:010 020
 9:@ED 9.,J8ADDCOP.BLOG/NOMO?
10:EXI
```

Figure 3-9. Sample Runstream to Reduce an ADDCOP File

3-6. SUMMARY. This chapter has described the programs developed by the POSTFOR Study to reformat FORCEM results for input to the ADDCOP graphics postprocessor.

CHAPTER 4

EQUIPMENT AND FUEL REQUIREMENTS

4-1. INTRODUCTION. This chapter describes how the Combat Operational Readiness Float (CORF) Factors, Wartime Replacement Factors (WARF), and Wartime Fuel Factors (WAFF) Postprocessors, which were designed for use with CEM in analyses of materiel requirements, have been adapted to operate as postprocessors to FORCEM.

4-2. METHODOLOGY. The POSTFOR Study determined that the existing methodology of each of these three postprocessors is satisfactory for use with FORCEM, and should be retained. FORCEM can provide all the data that are required by each of these postprocessors, and can provide these data for more categories of equipment than are available from CEM.

4-3. CORF FACTORS POSTPROCESSOR. To support the CORF Factors Postprocessor, modifications were made to the FORCEM program code and, in addition, an interface program was designed and implemented to transform the results reported by FORCEM into the formats required as input by the CORF Factors Postprocessor.

a. FORCEM was modified to establish an operational readiness float (ORF) authorization at each echelon as a percentage (input) of the number of vehicles authorized to the equipment pool at that echelon for each of nine equipment subcategories for each national partition; to read the ORF fill percentage criterion and the repair time criterion for each side; to fill the SUPCOMs at specified echelons with ORF stocks based on equipment pool densities and ORF authorizations; to issue ORF stocks in lieu of completing current repair work, based on the repair time criterion and the ORF fill percentage criterion; and to keep track of the issues from ORF stocks and report them periodically for each equipment type. These ORF modifications are presently deactivated within the FORCEM Model code.

(1) Authorized ORF stocks of each equipment type are established for each SUPCOM based on authorized levels in the equipment pool of the parent headquarters. After authorizations are established, the normal equipment resupply system will be required to fill the authorizations with equipment available for issue. These SUPCOMs then compete for available equipment assets on an equal footing with all other units needing replacements. Hence it may be several model cycles before a particular SUPCOM will be able to support the issue of ORF stock. ORF stocks are subject to attrition when a SUPCOM is attacked.

(2) An echelon criterion for issue of ORF stocks is also input for each side and is applied in the following way. Only the SUPCOMs at echelons above or equal to the input echelon, say corps, are authorized ORF stocks and can issue ORF stocks. The recipient of issued ORF stocks, the owner of the equipment in repair, can be at any echelon.

(3) The ORF inputs are entered via the DATA2 (CSS) FORCEM input file. Relevant lines of a sample DATA2 file are shown in Figure 4-1, and are reasonably self-explanatory. ORF issues are reported in the FORCEM (R65) CORF Issue Report, a sample of which is shown in Figure 4-2.

```
INPUT DATA FOR CSS MODULE OF FORCEM.
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ORF DATA FOLLOWS. ISSUE IS MAX TIME BEFORE ISSUE MADE, FILL IS
TARGET FILL PERCENTAGE, ECH IS LOWEST ECHELON AT WHICH ORF WILL
EXIST. WHEN ORF.FILL.BLUE(RED) IS SET, THE MODEL AUTOMATICALLY FILLS
ORF STOCKAGE IN APPROPRIATE UNITS. IF NOT SET TO "TRUE" (1), NO
AUTOMATIC ISSUE ACTION IS TAKEN.
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ISSUE.BLUE     ISSUE.RED     FILL.BLUE     FILL.RED    ECH.BLUE    ECH.RED
ORF.FILL.BLUE   ORF.FILL.RED(ORF NOT PLAYED)
    24              0             90            100          3           4
     1              0
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
THE FOLLOWING ARRAY IS THE ORF ARRAY WHICH DESIGNATES THE MAX
AUTHORIZATION FOR EACH VEHICLE CLASS INDEPENDENT OF ECHELON.
ROWS CORRESPOND TO PARTITIONS.
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
80      80      00      00      00      30      00      50      00
00      00      00      00      00      00      00      00      00
00      10      00      00      00      00      00      00      00
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Figure 4-1. Sample ORF Inputs to FORCEM

OPERATIONAL READINESS FLOAT REPORT

TIME OUT (HOURS)	TIME BACK (HOURS)	GIVING SUPCOM	RECEIVING UNIT	PARTITION RECV UNIT	ASSET NUMBER	QUANTITY ISSUED
96	107	32000	2203	1	1	1
96	107	32000	2201	1	2	1
96	104	32000	2203	1	23	1
96	104	133020	103024	3	53	1
96	104	133020	103024	3	53	1
96	104	132010	102014	3	53	1
96	104	132010	102014	3	53	1
96	104	131020	101023	3	53	1
96	104	131020	101023	3	53	1
120	128	30000	2102	1	23	1
120	128	30000	2102	1	14	1
120	128	133020	103024	3	53	1

Figure 4-2. Sample ORF Issues Report

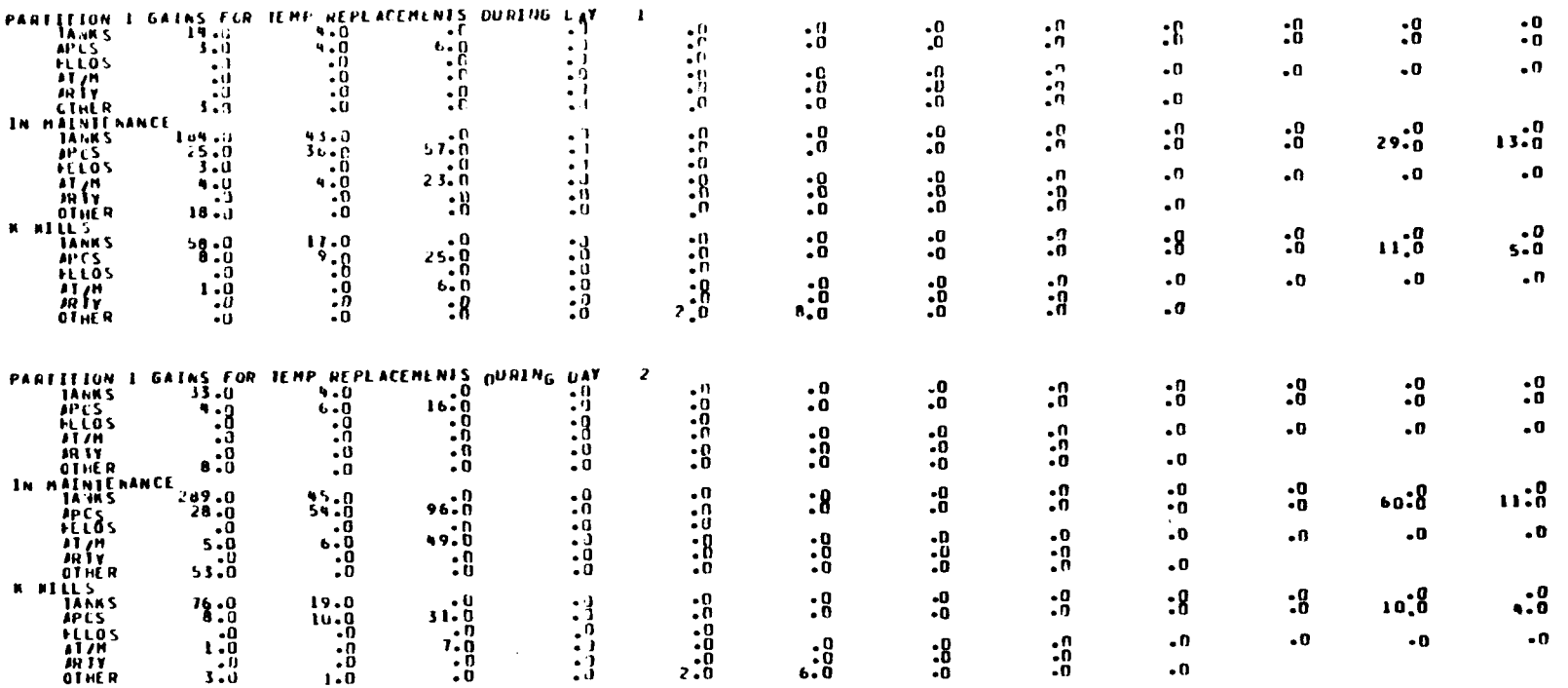
b. A new program, FCORF, has been designed, coded (in ASCII FORTRAN), and tested in the POSTFOR Study to reformat the pertinent FORCEM results as required by the existing CORF Factors Postprocessor.

(1) This FCORF program reads permanent combat losses and quantity in repair from the FORCEM Loss and Consumption (R64) Report (unit 14) and the quantities issued from ORF stocks, partition 1 (US), from the FORCEM CORF Issue (R65) Report (unit 15). An input record is read from the system input stream (unit 5), containing the number of days simulated in FORCEM. A sample runstream for the FCORF program is shown in Figure 4-3.

```
1:@FREE  9.
2:@ASG,A 71-C30434R64.
3:@USE 14.,71-C30434R64.
4:@ASG,A 71FASTALS.
5:@ASG,A 71-C30434R65.
6:@USE 15.,71-C30434R65.
7:@ASG,T 9.
8:@XQT 71PFOR.385CORF
9.010
10:@CO 9.,71FASTALS.CORF/4MAR86
11:EXI
12:@FREE 15.
13:@FREE 14.
```

Figure 4-3. Sample Runstream of FORCEM-CORF Interface Program

(2) This FCORF program writes to unit 9 a report formatted for input to the CORF Factors Postprocessor. This report contains, at 24-hour intervals, the quantities from FORCEM national partition 1, by equipment type, of issues from ORF stocks, of equipment in repair, and of permanent combat losses. The report contains one line each for tanks, APCs, helicopters, antitank/mortars, artillery, and "other"--which includes trucks, two types of recovery vehicles, and up to six types of air defense weapons. A sample of this report is shown in Figure 4-4.



```
PARTITION 1 GAINS FOR TEMP REPLACEMENTS DURING DAY  1
     TANKS      19.0        9.0         .0          .0          .0          .0          .0          .0          .0          .0
     APCS        3.0        4.0        6.0          .0          .0          .0          .0          .0          .0          .0
     HLLOS        .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     AT/M         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     ARTY         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     OTHER       3.0         .0         .0          .0          .0          .0          .0          .0          .0          .0
IN MAINTENANCE
     TANKS     104.0       43.0         .0          .0          .0          .0          .0          .0          .0          .0
     APCS       25.0       36.0       57.0          .0          .0          .0          .0          .0         29.0        13.0
     HLLOS       3.0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     AT/M        4.0        4.0       23.0          .0          .0          .0          .0          .0          .0          .0
     ARTY         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     OTHER      18.0         .0         .0          .0          .0          .0          .0          .0          .0          .0
K HILLS
     TANKS      50.0       17.0         .0          .0          .0          .0          .0          .0          .0          .0
     APCS        8.0        9.0       25.0          .0          .0          .0          .0          .0         11.0         5.0
     HLLOS        .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     AT/M        1.0         .0        6.0          .0          .0          .0          .0          .0          .0          .0
     ARTY         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     OTHER        .0         .0         .0          .0         2.0         8.0          .0          .0          .0          .0

PARTITION 1 GAINS FOR TEMP REPLACEMENTS DURING DAY  2
     TANKS      33.0        9.0         .0          .0          .0          .0          .0          .0          .0          .0
     APCS        9.0        6.0       16.0          .0          .0          .0          .0          .0          .0          .0
     HLLOS        .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     AT/M         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     ARTY         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     OTHER       8.0         .0         .0          .0          .0          .0          .0          .0          .0          .0
IN MAINTENANCE
     TANKS     289.0       45.0         .0          .0          .0          .0          .0          .0          .0          .0
     APCS       28.0       54.0       96.0          .0          .0          .0          .0          .0         60.0        11.0
     HLLOS        .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     AT/M         .0        6.0       49.0          .0          .0          .0          .0          .0          .0          .0
     ARTY         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     OTHER       53.0         .0         .0          .0          .0          .0          .0          .0          .0          .0
K HILLS
     TANKS      76.0       19.0         .0          .0          .0          .0          .0          .0          .0          .0
     APCS        8.0       10.0       31.0          .0          .0          .0          .0          .0         10.0         4.0
     HLLOS        .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     AT/M         .0         .0        7.0          .0          .0          .0          .0          .0          .0          .0
     ARTY         .0         .0         .0          .0          .0          .0          .0          .0          .0          .0
     OTHER       3.0        1.0         .0          .0         2.0         6.0          .0          .0          .0          .0
```

Figure 4-4. Sample Output of FORCEM-CORF Interface Program

4-4. WARF POSTPROCESSOR. The WARF-FORCEM linkage was designed and implemented by personnel of the Requirements Division by modifying the existing WARF Postprocessor (designed for use with data from CEM) in such a way that, with minimal operator intervention, it will accept data from either CEM or FORCEM. This approach minimizes the training required for operators of the WARF Postprocessor, who will have to determine equipment requirements for some studies using CEM simulations and other studies using FORCEM simulations. Since CEM is still to be used for some future studies, this approach minimizes the work required for documentation, maintenance of computer files and runstreams, and configuration management for WARF post-processing. Finally, this approach maximizes consistency between WARF methodologies for CEM and the FORCEM.

a. The existing WARF Postprocessor reads the following six files.

(1) Item Identification. This file contains a recap of the LOGSACS tapes, including theater quantities authorized, by line item number (LIN), of the items of Army equipment for which WARF is to be computed.

(2) Historical Data. This file gives historical loss rates for losses of equipment to causes not simulated in CEM or FORCEM, such as pilferage, sabotage, etc. (It should be noted here that CEM and FORCEM apply an input factor for each equipment type to represent losses to noncombat causes. Therefore, the quality of the theater campaign simulation can be enhanced by including as many as possible of the "historical" causes of equipment loss in the noncombat-loss or "breakdown" factor applied in CEM and FORCEM, thereby reducing the available quantities of equipment during the campaign, rather than applying the historical factors in a postprocessor.)

(3) Control File. This file provides parameters to control the WARF computer programs. Examples of these control parameters are: the number of days simulated in CEM, the time periods for which WARF rates are requested, and identification of the items of US Army equipment simulated in CEM.

(4) Logistic Report. A CEM output report used to obtain the quantity (by weight) of Red artillery munitions fired against Blue combat units.

(5) Engagement Report. This CEM output report lists, for each day, for each Blue national partition and for each posture, the number of Blue maneuver battalion engagements that occurred in the CEM simulation.

(6) WARF Data. This CEM output file reports, for each major weapon system (12 tank types, 12 APC types, 5 helicopter types, 12 antitank/mortar types, and 8 artillery types), the number authorized and the number permanently lost to combat and to abandonment (due to loss of terrain) for each 12-hour period of the simulation.

b. In order to develop WARF-FORCEM (that is, to link the existing WARF Postprocessor to the FORCEM), it was necessary to include additional parameters in the Control File, which entailed modification of the WARF computer routine that processes the Control File. In addition, three new routines were added to the WARF Postprocessor in order to process the FORCEM Loss and Consumption Report (R64), Type of Engagement Report (R66), and Indirect Fire Ammunition Report (R67), respectively. The type of information that is obtained from the FORCEM R67, R66, and R64 reports is very similar to the type found in the CEM Logistic Report, Engagement Report, and WARF Data files, respectively.

c. The routine, RCONTROL, that processes the Control File was modified to read three additional parameters from the Control File. These three parameters are input as answers to queries directed to the WARF operator by the WARF interactive program, as shown in Table 4-1.

Table 4-1. FORCEM-WARF Control Queries

Question	Operator response
CEM OR FORCEM	1 (if CEM is used) 2 (if FORCEM is used)
FORCEM HRS PER PERIOD	12 (example)
FORCEM D-DAY STARTS AT HR	240 (example)

(1) The first parameter directs the WARF program to call either the routines for processing the three CEM files or the routines for processing the FORCEM R67, R66, and R64 reports.

(2) The second parameter is necessary because the FORCEM reports by time period, whose duration in hours may vary between studies.

(3) Unlike CEM, FORCEM permits modeling of a "mobilization" period before D-day. The third parameter indicates the length of this mobilization time prior to shots being fired in the FORCEM simulation, so that the WARF Postprocessor will exclude data from the mobilization period. In the example given in Table 4-1, the first 240 hours of FORCEM data would be skipped by the WARF Postprocessor.

d. In addition to the change necessary to consider the above three parameters, the RCONTROL routine required modification to accommodate some differences in the representation of weapon numbers between the CEM and the FORCEM output reports. The CEM WARF Data file numbers the Blue artillery as weapons 42-49, whereas the FORCEM R64 report numbers the Blue direct-support artillery as weapons 43-50, and reports small arms or infantry weapons as weapon number 42.

e. Three new routines, called R67, R66, and R64, have been added to the WARF Postprocessor to read the FORCEM R67, R66, and R64 reports, respectively, when the WARF Postprocessor is operated in the WARF-FORCEM mode.

f. The processing of the FORCEM Indirect Fire Ammunition (R67) Report is performed as follows:

(1) Each record in the R67 report is read and tested against specific selection criteria. If the selection criteria are not met, the record is bypassed. The selection criteria used for each record are:

(a) The hour (field 1 of the record) must be greater than or equal to the hours-before-D-day parameter discussed above.

(b) The national partition (field 2 of the record) must match the specified partition parameter for which WARF rates are desired. This parameter (value 1 or 2) is an input to routine RCONTROL (1 signifies US, 2 signifies US Allies).

(c) The hour read is converted to days in order to determine to what day relative to D-day the record belongs. For selection, the computed day must not be greater than the number of days specified as input to routine RCONTROL.

(2) Once the record has been selected for further processing, the weight of artillery and tactical aircraft (TACAIR) munitions (fields 3 and 4 of the record) delivered against targets belonging to the partition specified is credited to the appropriate day.

(3) Consistent with the WARF-CEM methodology, the daily weight of artillery munitions is converted into a relative index by dividing each daily total weight by the maximum daily total weight that occurred during the simulation. We call this index the daily artillery intensity index.

(4) The daily TACAIR intensity index is computed in the same way as the daily artillery intensity index.

(5) When the WARF Postprocessor is operated in the WARF-CEM mode, a single daily artillery intensity index is used as a multiplicative factor against the attrition caused by the Red artillery and TACAIR missions. CEM does not output the data required to compute a separate daily TACAIR intensity index. When the WARF Postprocessor is used in the WARF-FORCEM mode, it has the capability to compute two separate daily indices to be applied against the appropriate attrition. In order to have the capability to compare what effect this change in methodology has on the computed WARF, we have retained the capability, as a user's option, to revert to the use of the daily artillery intensity index in lieu of TACAIR attrition when operating in the WARF-FORCEM mode, but the use of both artillery and TACAIR indices should be the norm.

(6) The capability to use a daily TACAIR intensity index other than what was computed using the TACAIR output data from FORCEM was implemented by allowing the inclusion of any desired number of records in the WARF Control File. Each of these records will be of the form (n m x) where n and m are the beginning and ending days addressed by the record, and x can have the value of (-1), or any real positive number. The value of (-1) directs the WARF Postprocessor to copy the daily artillery intensity index into the daily TACAIR intensity index array for the days specified in the record. A positive real value of x directs the WARF Postprocessor to use the value of x as the daily TACAIR intensity index for the days specified in the record. Note that a single record (1 180 -1) would force the WARF Postprocessor to use the WARF-CEM methodology as it pertains to the daily intensity indices, even when used in the WARF-FORCEM mode.

g. The new R66 routine reads the FORCEM Type of Engagement (R66) Report when the WARF Postprocessor is operated in the WARF-FORCEM mode. The processing of the R66 data proceeds as outlined below.

(1) Each record in the R66 file is read and tested against specific selection criteria. If the selection criteria are not met, the record is bypassed. The selection criteria used for each record are identical to the criteria used in routine R67 (see paragraph 4-4f(1)).

(2) Once the record has been selected for further processing, the next seven fields (fields 3 through 9) of the record are read. The seven fields represent the number of divisions that are in each of seven FORCEM postures.

(3) The seven FORCEM postures are allocated among the CEM postures using the following equivalency scheme:

(a) Field 3 - FORCEM Blue attack/Red defend (BAT/RDF) posture. This posture is equivalent to the total of two CEM postures (Blue attack prepared defense, BAPD; and Blue attack hasty defense, BAHD). Half of the FORCEM BAT/RDF division engagements were allocated to each of the CEM BAPD and BAHD postures.

(b) Field 4 - FORCEM Blue attack/Red delay (BAT/RDE) posture. Maps directly to CEM Blue attack delay (BAD) posture.

(c) Field 5 - FORCEM Red attack/Blue defend (RAT/BDF) posture. Equivalent to the total of two CEM postures (Red attack hasty defense, RAHD; and Red attack prepared defense, RAPD). Half of the FORCEM RAT/BDF division engagements were allocated to each of the CEM RAHD and RAPD postures.

(d) Field 6 - FORCEM Red attack/Blue delay (RAT/BDE) posture. Maps directly to CEM Red attack delay (RAD) posture.

(e) Field 7 - FORCEM static posture. Maps directly to CEM static posture.

(f) Field 8 - FORCEM not engaged/moving (NE/M) posture. The number of divisions in this posture, plus the number of divisions from field 9 (see below) were allocated to the CEM reserve posture.

(g) Field 9 - FORCEM not engaged/not moving (NE/NM) posture. Same as field 8.

(4) FORCEM does not make a terrain distinction in the R66 report, while CEM reports engagements in each of three terrain types. In order to convert the FORCEM terrain-independent engagements, the FORCEM engagements are divided equally among the terrain types (three) for each day.

(5) Since CEM reports battalion engagements, the division engagements reported by FORCEM are converted to equivalent battalion engagements. The conversion process is based on the assumption that there are eleven battalions in one division (i.e., 10 maneuver and 1 armored cavalry squadron). The constant eleven (11) is used to multiply the number of engagements for each posture and each terrain for every day of the 180-day conflict.

(6) After completion of the above processes the subroutine ENGAGEIN2 is called to compute the percent of the force that is in each of the postures and terrain types, for each day of conflict.

(7) Some of the assumptions that were made in mapping the FORCEM postures into equivalent CEM postures are in no way to be misconstrued as limitations to the WARF process. The reader should keep in mind that the posture profile, expressed as a percent of the total force, is merely used as a weighting factor for COSAGE sample results. In this context, the number of maneuver battalions assumed per division has no effect on the results, as long as it is the same number for every division. Also, if the COSAGE samples are not differentiated by terrain type, the same COSAGE sample will be used in three separate terms, each term weighted by one-third of the terrain-independent posture profile. The result would be identical (not merely equivalent) if the COSAGE sample had been weighted by the total terrain-independent posture profile. Conversely, these assumptions were made in order to:

(a) Allow comparisons of posture profiles with past or other studies using CEM.

(b) Keep the WARF routines flexible enough to meet an eventual requirement to generate and use terrain-dependent COSAGE samples (it has occcurred before, with the P90K Study).

h. The new R64 routine reads the FORCEM Loss and Consumption (R64) Report, described in Appendix D, when the WARF Postprocessor is operated in the WARF-FORCEM mode. Processing of the R64 data proceeds as outlined below.

(1) Each record in the file is read and tested against specific selection criteria. If the criteria are not met, the record is bypassed. The selection criteria are:

(a) The hour (field 1) must be greater than or equal to the hours-before-D-day parameter discussed above.

(b) The partition (field 2) must match the specified parameter as explained in 4-4f(1)(b) above.

(c) Asset type (field 4) indicates the type of weapon system (i.e., a particular LIN). Selection is based on an ordinal number in the range of 1 to 51, excluding 42 for personnel (see paragraph 4-4d).

(d) Category (field 5) must be equal to 3, indicating that the record pertains to Blue major weapon systems (tank, APC, helicopter, antitank/mortar, artillery and close air support).

(e) Record type (field 7) must be either 1 or 2. The record type indicates the contents of field 8. In record type 1, field 8 reports the number of equipment authorized by TOE. In record type 2, field 8 reports the permanent combat losses, including abandonment.

(2) Further processing of a selected record is as follows:

(a) Asset type (field 4) is used as a search key to determine if the weapons system read from R64 is included in the set of weapons to be evaluated.

(b) Hour, value in field 1, is converted to the current day relative to D-day.

(c) If record type (field 7) is equal to 1, then the authorized quantity (field 8) is read, multiplied by the fraction of the day covered by the record, and added to the cumulative weighted average authorized quantity for the current day. In other words:

$$\text{Average TOE for day } n = \sum_{i=1}^{m} X_i \, (H/24)$$

Where H = hours per FORCEM time period
m = number of FORCEM time periods per day
X_i = authorized quantity from field 8

(d) If record type (field 7) is equal to 2, then the permanent combat loss is read and added to the cummulative total losses for a given weapon system for the current day.

(3) From the FORCEM Consumption and Loss (R64) Report the WARF Post-processor reads the authorized quantity of each type weapon and the permanent combat loss of each type weapon. It is assumed that the permanent combat loss reported by FORCEM includes all losses due to abandonment

caused by enemy seizure of terrain. At present FORCEM does not subject noncombat repairable damage to this type of abandonment, but if FORCEM is changed in the future, it is necessary to the WARF Postprocessor that all repairable equipment abandoned because of an advancing enemy be reported as permanent combat loss.

i. An operational test of the FORCEM WARF Postprocessor (described in Reference 3) was conducted by personnel of the Requirements Division using the results of a FORCEM simulation of 30 days of combat in Europe. The inputs to the FORCEM simulation were essentially those of the OMNIBUS-85 Study, with the addition of ammunition "add-on factors" for both sides. The results of this operational test, which cannot be published in this unclassified report, were compared with the WARF rates obtained from the OMNIBUS-84 Study using the existing (CEM) WARF Postprocessor. There are many differences between the assumptions and methodology of the OMNIBUS-84 and OMNIBUS-85 Studies, as noted in paragraph 2-7c, but the comparison of the WARF rates of the two studies illuminates certain features of the FORCEM WARF Postprocessor.

(1) The theater authorized quantity of each weapon, as reported in the FORCEM Loss and Consumption Report (R64), includes equipment in FORCEM equipment pools and other units which were not included in the existing (CEM) WARF Postprocessor. These additional weapons appearing outside of maneuver and artillery battalions in FORCEM can have the effect of reducing WARF rates if they are counted in the authorized theater quantity but suffer negligible attrition. One solution to this difficulty is to obtain authorized weapon quantities, over time, from a source other than the FORCEM R64 report. Another solution is to assign equipment pools and other FORCEM "units" not to be included in the WARF computations to a national partition other than the US, so that the weapons in such units can be distinguished in the FORCEM R64 Report and can be excluded from the WARF calculations.

(2) In calculating WARF rates for equipment not played in FORCEM, the FORCEM WARF Postprocessor applies an artillery intensity index that varies daily, based on the tonnage of enemy artillery ammunition expended each day in the FORCEM US division engagements, as described in paragraph 4-4f, above. The CEM WARF Postprocessor applies an artillery intensity index that varies by four-day periods Each day's artillery intensity index is obtained by dividing that day's enemy artillery expenditure by the maximum daily enemy artillery expenditure that occurred during the simulation. Hence a single day of very high (relative to the mean) enemy expenditures can cause the artillery intensity index (a number between 0 and 1 that multiplies the attrition) for every other day simulated to be low. The maximum daily expenditure is higher relative to the mean daily expenditure than is the maximum four-day expenditure relative to the mean four-day expenditure. Consequently, the daily artillery intensity indices of the FORCEM WARF will generally be lower than the four-day intensity indices of the CEM WARF.

(3) The FORCEM R64 Report should be examined after preliminary FORCEM runs to ensure that all equipment for which WARF rates are wanted are suffering permanent and temporary combat losses as expected; otherwise errors can go unnoticed and uncorrected in the linkage from COSAGE to FORCEM and in the FORCEM input parameters for rear-area attrition.

(4) The losses reported in the FORCEM R64 report can include attrition in rear areas by tactical aircraft, by general support artillery, and by surface-to-surface missiles. For consistency with CEM, targeting of ports, POMCUS sites, equipment pools, and general support artillery battalions outside of division engagements can be prevented by input to FORCEM. However, the combat attrition of artillery providing general support is a FORCEM feature that represents an improvement in realism over CEM and probably should be used.

4-5. FUEL FACTORS POSTPROCESSOR. The existing Fuel Factors Development Postprocessor determines wartime fuel factors (WAFF) by reading the same CEM output reports as are read by the WARF Postprocessor. Consequently, in order to minimize the effort required for documentation, operator training, program maintenance, and configuration management, the Fuel Factors Postprocessor is being combined with the WARF Postprocessor. The Fuel Factors Postprocessor then can be selected as an option whenever the WARF Postprocessor is executed. This also provides a linkage from FORCEM to the Fuel Factors Development Postprocessor, since the WARF Postprocessor has already been linked to FORCEM. The work on the Fuel Factors Postprocessor has been done by personnel of the Requirements Division of CAA.

4-6. SUMMARY. This chapter has described the linkage developed by the POSTFOR Study of FORCEM to the CORF, WARF, and WAFF Postprocessors, which are used in materiel and fuel requirements analyses.

CHAPTER 5

AMMUNITION REQUIREMENTS

5-1. INTRODUCTION. This chapter describes the methodology, computer routines, runstreams, and inputs of the approach developed by the POSTFOR Study for determination of requirements for ammunition and air defense missiles.

a. The existing Ammunition Postprocessor (APP), documented in Reference 2, could be modified to accept campaign simulation results in FORCEM, rather than CEM, report formats. The existing APP, in very general terms, reads from CEM simulation results the combat damage to Red equipment and personnel by US weapons other than TACAIR in each posture, reads the number of each type of US weapon engaged in each posture, and refers to COSAGE samples for each posture to determine, by an equivalent stylized day methodology, the number of rounds expended by each US weapon to inflict this combat damage on Red assets. The combat losses of US equipment reported by CEM are used to calculate the onboard losses of ammunition on combat damaged vehicles. The onboard losses, zeroing, registration, logistic losses, and other categories of ammunition consumption are all applied in the APP and are not reflected in the CEM simulation. The only way to represent in CEM the effect of the ammunition consumption added in the APP is to increase the weight of the munition input to CEM by a factor which cannot vary with time. The POSTFOR Study has determined that it is preferable to replace the existing APP as FORCEM is phased in, for the following reasons.

(1) In order to represent accurately the impact on the campaign simulation of noncombat consumption of ammunition, such as zeroing of weapons, functional checks, logistic losses, etc., this consumption should be added to transportation workloads and deducted from ammunition stocks in the FORCEM, rather than introduced after the campaign simulation, as the existing APP does. The campaign simulation is made more realistic by playing more of the ammunition consumption factors in FORCEM, rather than in a postprocessor.

(2) FORCEM should permit a more realistic accounting of ammunition consumption categories, such as logistic losses and expenditures against support units than is possible by applying a factor in a postprocessor. The representation of rear areas and support units and convoys that are subject to attrition is more detailed in FORCEM than in CEM.

(3) The existing APP cannot be expected to match the ammunition consumption reported by CEM, because the APP does not directly use the ammunition consumption reported by the campaign simulation. Thus, for example, the requirements for ammunition handling companies determined from the ammunition consumed in a CEM simulation might not be sufficient to process the ammunition that the APP says is required for the same CEM

simulation. The methodology developed by the POSTFOR Study for determining ammunition requirements ensures consistency between FORCEM and its post-processor.

b. When the POSTFOR methodology was being developed, no linkage existed between CEM and a postprocessor to calculate air defense missile requirements. In the absence of an existing methodology for air defense munitions requirements, the POSTFOR Study has elected to handle air defense missiles in the same way as the other munitions in the FORCEM ammunition post-processor. That is, FORCEM will report in detail all consumption of each type of air defense munition. To the consumption in FORCEM, the ammunition postprocessor will add only sea losses in determining requirements. The present FORCEM logic for tactical aircraft-air defense engagements will be used, until the demand for greater accuracy and realism warrants devoting programer time and FORCEM running time to the refinement of the modeling of tactical air and air defense. More recently, an Air Defense Missile Post-processor (ADMP) has been developed by CAA and linked to CEM. The methodology of the ADMP is conceptually similar to the POSTFOR approach, in that the ADMP reads from a CEM report the number of rounds fired of each air defense munition.

5-2. AMMUNITION REQUIREMENTS PROCESS. The ammunition requirements methodology developed by the POSTFOR Study is depicted in schematic form in Figure 5-1. Each of the steps in this process is described in some detail in paragraphs 5-3 to 5-7.

a. FORCEM receives attrition calibration input from the Combat Sample Generator (COSAGE) and will require new ammunition consumption and loss "add-on" inputs to determine the rounds consumed by each FORCEM weapon. FORCEM will produce four reports used by the ammunition postprocessor: The Ammunition Consumption Report (D36), Ammunition Fired Report (D37), Air Deep Target Interdiction Report (R43), and Artillery Damage Report (R52).

b. The first postprocessor program, AMOHIT, prorates the American ammunition destroyed by enemy fire among FORCEM weapons and adds these losses to the logistic losses in the D36 report.

c. The COSAGE-APP Linkage Program (CALP) routine reads COSAGE results to determine, of the rounds fired by each weapon at each target, the percentage attributed to each munition of the weapon. (A number of different munitions may be "rolled up" into the two munitions per weapon that can be represented in FORCEM).

d. After the operator has constructed the Ammo Expenditure Data File (described in pp 79-82 and 90-92 of Reference 2), the PFDATA program prorates each FORCEM weapon's ammunition consumption among the weapons of interest that are "rolled up" into the FORCEM weapon. The prorating is based on the deployed densities, by APP time period, of the weapons of interest. The results are inserted into the Ammo Expenditure Data File.

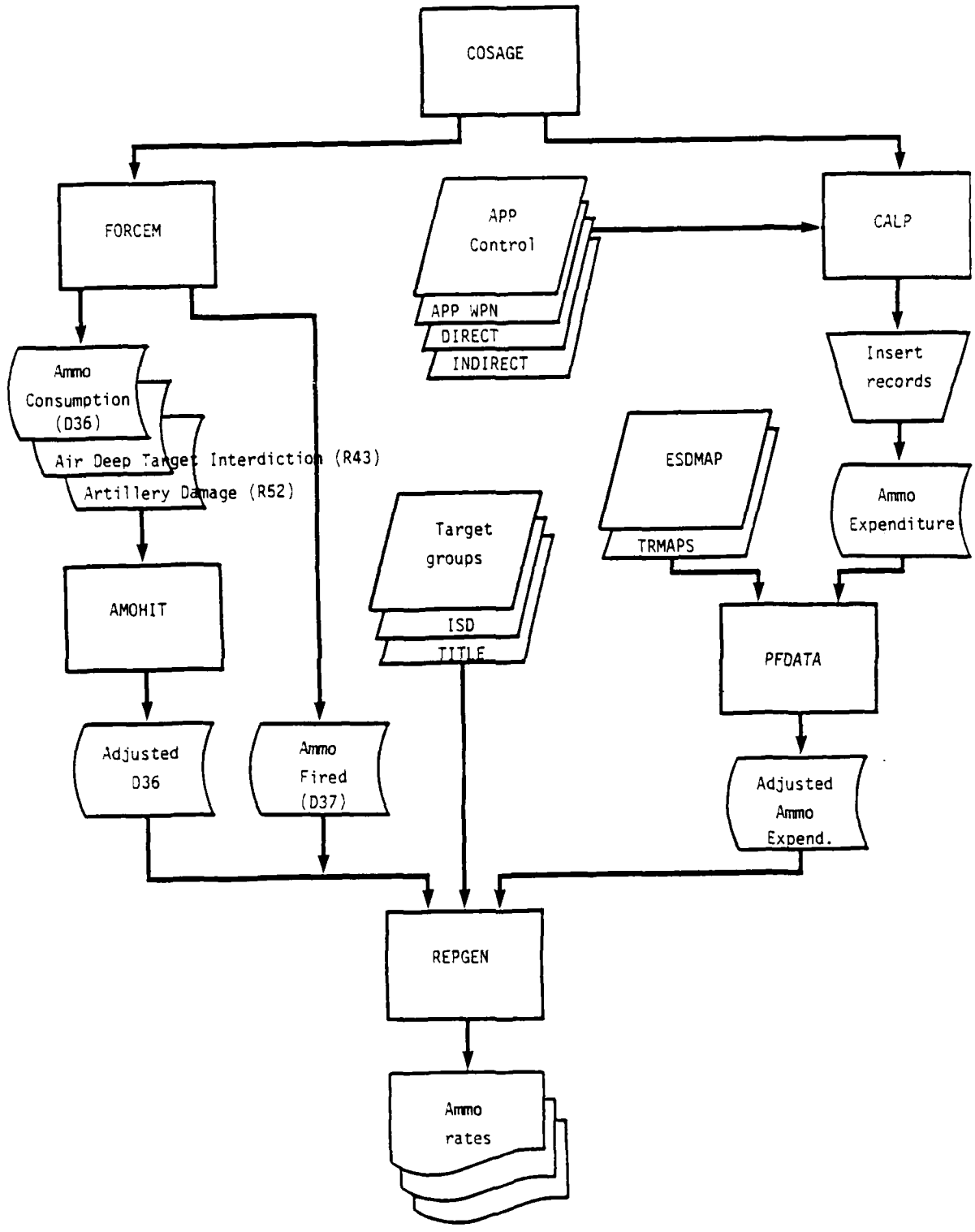


Figure 5-1. FORCEM Ammunition Requirements Methodology

e. The REPGEN program reads the FORCEM D36 and D37 reports, as well as the Ammo Expenditure Data File, target group definitions, and ISD and Title Files (described in pp 78-79 of Reference 2), calculates the consumption rates of each munition, and generates the same reports as the existing APP.

5-3. FORCEM FOR AMMUNITION REQUIREMENTS

a. FORCEM will require as input, for each FORCEM weapon, all the factors necessary to determine, by weapon type, the numbers of rounds consumed in all categories of combat and noncombat consumption. These inputs include:

(1) The FORCEM ammunition resupply pot (between 1 and 4) from which the weapon's ammunition is drawn;

(2) The number of rounds expended per 12-hour FORCEM cycle per weapon for function checks or registration firing;

(3) The weapon's burst size (i.e., the number of rounds fired per COSAGE-ATCAL "shot"--the burst size is one for most weapons);

(4) The number of rounds expended whenever a weapon is zeroed;

(5) The number of rounds expended per FORCEM cycle for harassment and interdiction firing;

(6) The logistic loss factor, which is multiplied by the total of all consumption by the weapon to account for other noncombat losses (accidents, spoilage, pilferage, sabotage, etc.);

(7) The rounds required per weapon for rear area security (this is expended once for each weapon in an arriving unit as the unit passes through the theater rear); and

(8) A suspect target factor for each FORCEM engagement type and for general support firing.

b. These ammunition inputs to FORCEM are appended to the existing FORCEM Asset File. The ammunition resupply pot ((1) above) is an integer number; the others are real numbers, which may contain a decimal point. Each weapon's ammunition inputs are preceded by two integer numbers: the FORCEM asset number of the vehicle carrying the weapon, and the asset number of the weapon. A sample of the ammunition inputs is shown in Figure 5-2. The six suspect target factors for each weapon are ordered as follows:

(1) Blue attack, Red defend
(2) Blue attack, Red delay
(3) Red attack, Blue defend
(4) Red attack, Blue delay
(5) Static (neither side attacks)
(6) General support, not engaged

OWNER	AS-SET	PO T	FUNCT CHECK	BURST RATE	ZERO-ING	H E I FACTR	LOG LOSS	REAR SECURBAT	SUSPECT RDFBAT	SUSPECT RDLRAT	TARGET BDFRAT	TARGET BDLSTA	FACT TICNENGGS
1	317	1	4.	1.	5.	0.0	.02	2.	.10	.10	.10	.15	.20	0.0
1	288	4	40.	4.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
2	318	1	4.	1.	5.	0.0	.02	5.	.10	.10	.10	.15	.20	0.0
2	289	4	40.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
5	316	1	4.	1.	5.	0.0	.02	5.	.10	.10	.10	.15	.20	0.0
5	284	4	40.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
6	262	1	4.	5.	5.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
6	285	4	40.	10.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
7	319	1	4.	1.	10.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
7	283	4	40.	10.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
8	320	1	4.	1.	8.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
8	286	4	40.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
9	267	1	4.	1.	5.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
9	270	4	40.	5.	25.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
10	263	1	4.	1.	5.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
10	287	4	20.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
13	312	1	4.	1.	5.	0.0	.02	2.	.10	.10	.10	.15	.20	0.0
13	279	4	40.	4.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
14	313	1	4.	1.	5.	0.0	.02	5.	.10	.10	.10	.15	.20	0.0
14	280	4	40.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
15	281	1	4.	1.	5.	0.0	.02	5.	.10	.10	.10	.15	.20	0.0
16	271	4	40.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
17	311	1	4.	5.	5.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
17	278	4	40.	10.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
18	277	4	4.	1.	10.	0.0	.02	0.	.10	.10	.10	.15	.20	0.0
18	272	4	40.	10.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
19	273	4	40.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
20	274	4	40.	5.	25.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
21	275	4	20.	5.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
22	282	4	40.	10.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
23	314	4	0.	1.	0.	0.0	.02	2.	.10	.10	.10	.15	.20	0.0
23	276	4	40.	5.	25.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
24	266	4	0.	1.	0.	0.0	.02	2.	.10	.10	.10	.15	.20	0.0
25	302	4	0.	1.	0.	0.0	.02	2.	.10	.10	.10	.15	.20	0.0
25	269	4	40.	5.	25.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
26	301	4	5.	1.	5.	0.0	.02	12.	.10	.10	.10	.15	.20	0.0
30	307	4	40.	1.	25.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
31	309	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
32	310	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
33	315	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
36	304	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
37	303	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
38	308	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
39	306	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
40	305	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
42	264	4	20.	1.	50.	0.0	.02	50.	.10	.10	.10	.15	.20	0.0
43	294	2	20.	1.	10.	20.	.02	10.	.10	.10	.10	.15	.20	.15
44	298	2	20.	1.	10.	20.	.02	10.	.10	.10	.10	.15	.20	.15

Figure 5-2. Sample FORCEM Ammunition Inputs

c. The burst size is applied to nondivisional air defense weapons as well as to divisional weapons. The logistic losses are deducted from the ammunition stocks of the theater Support Command (SUPCOM) in the FORCEM. Other consumption is deducted from the ammunition of the unit owning the weapon. All consumption is limited by onhand ammunition (which will be unconstrained in ammunition requirements studies).

d. FORCEM will produce two ammunition reports: the Ammunition Fired (D37) Report, which reports the rounds fired by each type weapon in each posture at each target category; and the Ammunition Consumption (D36) Report, which reports, by category of consumption, the rounds of each FORCEM weapon consumed in vehicles hit by enemy fire, in zeroing of weapons, in harassment and interdiction fire, in logistic losses, in expenditures for rear area security, and in function checks (or registration) of weapons. The D36 report also reports, for each weapon, the weight of the weapon's ammunition consumed and the FORCEM ammunition resupply pot of its ammunition. Samples of these two FORCEM reports are shown in Figures 5-3 and 5-4.

(1) For example, the first line of numbers in Figure 5-3 indicates that, during the cycle beginning at hour 0, gun #2 of FORCEM asset #1 (the first type of tank) in units of the first national partition (US) in the first posture (Blue delay) fired 5 rounds at Red troops, 44 rounds at Red antitank or mortar systems, 2 rounds at the third Red APC type, 5 rounds at the fourth Red APC type, and no rounds at anything else.

(2) And the first line of numbers, for example, in Figure 5-4 indicates that during the 12-hour period beginning at hour 0 gun #2 of the first type of tank (FORCEM asset #1) in units of the first (US) national partition lost 41,077 rounds, 142,000 rounds, and 56,615 rounds aboard vehicles damaged by enemy fire in Blue delay, defend, and attack postures, respectively. In addition 300 rounds of this gun's munition were expended in zeroing weapons returned to combat units from repair and 2,200 rounds in zeroing weapons issued from equipment pools to combat units. Also, 34,947 rounds of this gun were consumed in logistic losses and 107,040 rounds in function checks. All these consumption categories plus the rounds fired at enemy targets weigh 249,900 pounds. Ammunition for this gun is drawn from the fourth ammunition resupply pot, known as "other ammunition."

e. Onboard losses, that is, losses of ammunition aboard vehicles hit by enemy fire, are reported in the D36 report for each of four postures: Blue delay, Blue defend, static, and Blue attack. Zeroing is reported separately for each of four events: weapons deploying to the theater of operations, weapons returned to a combat unit from repair, weapons issued to a combat unit from an equipment pool, and weapons returned from general support repairs to an equipment pool.

AMMUNITION (ROUNDS) FIRED AT TARGET

TARGET TYPE

A P C BY T Y P E

TIME (HR)	AS-SETTN	NAGUE	NG	T	TROOPS	TANKS	HELI	AT/M	ARTLRY	TACAIR												
0	1	1	2	1	5	0	0	44	0	0	0	0	2	5	0	0	0	0	0	0	0	0
0	1	1	2	2	0	0	0	114	0	0	17	0	6	22	0	0	0	0	0	0	0	0
0	1	1	2	4	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	20	344	0	0	0	0	601	0	18	95	0	0	0	0	0	0	0	0
0	1	1	1	2	28	869	0	0	0	0	1253	0	43	122	0	0	0	0	0	0	0	0
0	1	1	1	3	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	4	3	428	2	0	0	0	540	0	33	63	0	0	0	0	0	0	0	0
0	2	1	2	2	0	0	0	1428	0	0	0	0	42	225	0	0	0	0	0	0	0	0
0	2	1	1	2	0	358	0	0	0	0	197	0	10	56	0	0	0	0	0	0	0	0
0	2	1	1	4	0	53	0	0	0	0	59	0	11	17	0	0	0	0	0	0	0	0
0	13	1	1	2	5	466	0	0	0	0	238	0	22	109	0	0	0	0	0	0	0	0
0	13	1	1	4	0	90	0	0	0	0	71	0	8	12	0	0	0	0	0	0	0	0
0	13	1	2	2	449	0	1	3036	0	0	49	0	25	120	0	0	0	0	0	0	0	0
0	13	1	2	4	1163	0	0	23	0	0	125	0	26	39	0	0	0	0	0	0	0	0
0	14	1	1	1	5	85	0	0	0	0	108	0	5	10	0	0	0	0	0	0	0	0
0	14	1	1	2	10	421	0	0	0	0	483	0	20	71	0	0	0	0	0	0	0	0
0	14	1	1	3	0	7	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
0	14	1	1	4	0	63	0	0	0	0	87	0	6	10	0	0	0	0	0	0	0	0
0	14	1	2	1	204	0	0	184	0	0	17	0	2	3	0	0	0	0	0	0	0	0
0	14	1	2	2	598	0	0	1455	0	0	79	0	16	60	0	0	0	0	0	0	0	0
0	14	1	2	3	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	14	1	2	4	1759	0	2	43	0	0	115	0	37	60	0	0	0	0	0	0	0	0
0	23	1	1	1	8	207	0	0	0	0	192	0	12	29	0	0	0	0	0	0	0	0
0	23	1	1	2	15	769	0	0	0	0	498	0	42	118	0	0	0	0	0	0	0	0
0	23	1	1	3	0	8	0	0	0	0	14	0	0	1	0	0	0	0	0	0	0	0
0	23	1	1	4	0	223	0	0	0	0	214	0	13	71	0	0	0	0	0	0	0	0
0	24	1	1	2	3	100	0	0	0	0	114	0	3	3	0	0	0	0	0	0	0	0
0	25	1	1	1	7	60	0	0	0	0	15	0	2	6	0	0	0	0	0	0	0	0
0	25	1	1	2	20	406	0	0	0	0	23	0	1	9	0	0	0	0	0	0	0	0
0	25	1	1	3	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	25	1	1	4	8	156	0	0	0	0	26	0	4	6	0	0	0	0	0	0	0	0
0	30	1	1	2	1389	582	0	1447	161	0	87	0	260	570	0	0	0	0	0	0	0	0
0	30	1	1	4	9	0	0	0	7	0	5	0	3	6	0	0	0	0	0	0	0	0
0	31	1	1	1	1583	630	0	7239	34	0	698	0	284	911	0	0	0	0	0	0	0	0
0	31	1	1	2	1621	1178	0	20269	278	0	1770	0	708	4420	0	0	0	0	0	0	0	0
0	31	1	1	3	1	0	0	2	3	0	19	0	4	27	0	0	0	0	0	0	0	0
0	32	1	1	1	0	3	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0
0	32	1	1	2	1	125	0	0	0	0	0	0	12	39	0	0	0	0	0	0	0	0
0	32	1	1	4	0	9	0	0	0	0	0	0	3	6	0	0	0	0	0	0	0	0
0	43	1	1	2	203	365	0	1803	304	0	283	0	49	50	0	0	0	0	0	0	0	0
0	44	1	2	1	120	633	0	634	231	0	241	0	72	191	0	0	0	0	0	0	0	0
0	44	1	2	2	148	1746	0	2029	999	0	566	0	174	764	0	0	0	0	0	0	0	0
0	44	1	2	3	4	60	0	26	162	0	14	0	5	16	0	0	0	0	0	0	0	0
0	44	1	2	4	715	1211	4	258	6120	0	426	0	217	422	0	0	0	0	0	0	0	0
0	44	1	1	1	70	158	0	260	52	0	59	0	20	46	0	0	0	0	0	0	0	0
0	44	1	1	2	133	1207	0	1961	284	0	266	0	109	491	0	0	0	0	0	0	0	0
0	44	1	1	3	1	1	0	3	49	0	0	0	0	1	0	0	0	0	0	0	0	0
0	44	1	1	4	270	33	13	724	342	0	198	0	79	172	0	0	0	0	0	0	0	0
0	45	1	2	1	2	9	0	0	93	0	4	0	3	2	0	0	0	0	0	0	0	0
0	45	1	2	2	5	82	0	91	223	0	34	0	5	33	0	0	0	0	0	0	0	0
0	45	1	2	3	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
0	45	1	2	4	0	0	0	0	621	0	0	0	0	0	0	0	0	0	0	0	0	0
0	45	1	1	1	2	4	0	3	82	0	2	0	1	2	0	0	0	0	0	0	0	0
0	45	1	1	2	12	100	0	154	254	0	27	0	9	42	0	0	0	0	0	0	0	0
0	45	1	1	3	0	1	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0
0	45	1	1	4	0	0	0	2	67	0	0	0	0	0	0	0	0	0	0	0	0	0
0	52	3	2	1	515	0	0	327	0	0	0	9	0	0	0	0	0	0	0	0	59	0
0	52	3	2	2	15606	0	0	10523	0	0	65	16	2023	0	0	0	0	0	0	0	51	396
0	52	3	2	4	226	0	0	175	0	0	0	0	68	0	0	0	0	0	0	0	124	0
0	52	3	1	1	7	120	5	8	0	0	0	81	0	0	0	0	0	0	0	0	107	0
0	52	3	1	2	43	1191	55	52	0	0	536	909	1176	0	0	0	0	0	0	0	1169	0
0	52	3	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
0	52	3	1	4	5	114	7	0	0	0	0	13	48	0	0	0	0	0	0	0	170	0
0	53	3	2	1	88	0	0	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	53	3	2	2	1622	0	0	3105	0	0	0	0	50	0	0	0	0	0	0	0	0	105
0	53	3	2	4	100	0	0	134	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 5-3. Sample FORCEM Ammunition Fired Report

TIME (HR)	AS-SE	RAGU TN	NO	B DELAY	B DEFEND (ON-BOARD LOSS)	STATIC	R ATTACK	DEPLOY	ZEROING RPR-UNT	ZEROING POOL-UNT	GS-POOL	P & T FIRE	LOG LOSS	REAR SECURITY	FUNCTION CHECK	TOTAL 100-LH	PO T
0	1	1	2	41077.	14000.	0.	56615.	0.	300.	2200.	0.	0.	39947.	0.	107040.	2499.	4
0	1	1	1	2398.	6735.	0.	2757.	0.	30.	220.	0.	0.	2726.	0.	10704.	15962.	1
0	2	1	2	0.	40923.	0.	5077.	0.	150.	200.	0.	0.	7124.	0.	23200.	509.	4
0	2	1	1	0.	1408.	0.	183.	0.	15.	20.	0.	0.	471.	0.	2320.	3361.	1
0	13	1	1	0.	32.	0.	26.	0.	0.	5.	0.	0.	298.	0.	1892.	2049.	1
0	13	1	2	0.	13667.	0.	5000.	0.	0.	50.	0.	0.	4269.	0.	18920.	564.	4
0	14	1	1	46.	137.	0.	26.	0.	0.	0.	0.	0.	414.	0.	2536.	3960.	1
0	14	1	2	7250.	36250.	0.	4333.	0.	0.	0.	0.	0.	7986.	0.	25360.	1054.	4
0	15	1	1	0.	17700.	0.	5300.	0.	30.	0.	0.	0.	3407.	0.	11040.	750.	1
0	21	1	1	0.	0.	0.	0.	0.	100.	0.	0.	0.	1634.	0.	16240.	36.	4
0	23	1	2	1600.	8600.	0.	4400.	0.	0.	75.	0.	0.	5759.	0.	42920.	317.	4
0	23	1	1	37.	124.	0.	117.	0.	0.	0.	0.	0.	265.	0.	0.	2536.	4
0	24	1	1	0.	20.	0.	0.	0.	0.	0.	0.	0.	24.	0.	0.	232.	4
0	25	1	1	1.	2.	0.	0.	0.	0.	0.	0.	0.	76.	0.	0.	731.	4
0	25	1	2	25.	100.	0.	0.	0.	0.	0.	0.	0.	1548.	0.	15360.	681.	4
0	30	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	843.	0.	3960.	1604.	4
0	31	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	5460.	0.	12840.	24026.	4
0	32	1	1	0.	16.	0.	0.	0.	0.	0.	0.	0.	3928.	0.	38980.	20891.	4
0	42	1	1	70000.	840000.	0.	50000.	0.	0.	0.	0.	0.	136100.	0.	401000.	150.	4
0	43	1	1	0.	0.	0.	0.	0.	0.	0.	0.	1080.	522.	0.	1080.	1730.	2
0	44	1	2	0.	0.	0.	0.	0.	0.	0.	0.	14480.	4717.	0.	14480.	70408.	2
0	44	1	1	0.	0.	0.	0.	0.	0.	0.	0.	14480.	3595.	0.	14480.	53661.	2
0	45	1	2	0.	0.	0.	0.	0.	0.	0.	0.	4200.	961.	0.	4200.	21735.	2
0	45	1	1	0.	0.	0.	0.	0.	0.	0.	0.	4200.	918.	0.	4200.	26506.	2
0	46	1	1	0.	0.	0.	0.	0.	0.	0.	0.	1180.	236.	0.	1180.	21651.	2
0	52	3	2	5647.	79529.	0.	8471.	0.	0.	3400.	0.	0.	19202.	0.	64120.	1795.	4
0	52	3	1	350.	4951.	0.	550.	0.	0.	680.	0.	0.	1547.	0.	3236.	9375.	1
0	53	3	2	13833.	62833.	0.	28667.	0.	200.	400.	0.	0.	18997.	0.	78640.	1254.	4
0	53	3	1	788.	4600.	0.	1626.	0.	40.	80.	0.	0.	1135.	0.	1966.	6865.	1
0	54	3	2	0.	20833.	0.	0.	0.	0.	0.	0.	0.	3028.	0.	8800.	200.	4
0	54	3	1	0.	986.	0.	0.	0.	0.	0.	0.	0.	170.	0.	440.	1058.	1
0	55	3	2	20400.	28800.	1200.	24800.	0.	0.	1950.	0.	0.	11722.	0.	39080.	322.	4
0	55	3	1	1055.	1478.	63.	1309.	0.	0.	390.	0.	0.	683.	0.	1554.	4088.	1
0	64	3	2	15200.	66800.	0.	21200.	0.	0.	9600.	0.	0.	21808.	0.	110280.	600.	4
0	64	3	1	1696.	7333.	26.	2366.	0.	0.	1840.	0.	0.	4429.	0.	27570.	7454.	4
0	66	3	1	471.	2000.	0.	1765.	0.	0.	650.	0.	0.	3401.	0.	29120.	318.	4
0	67	3	1	2353.	14624.	0.	3487.	0.	0.	0.	0.	0.	10590.	0.	84840.	990.	4
0	70	3	2	0.	0.	0.	0.	0.	0.	0.	0.	0.	512.	0.	5120.	14.	4
0	70	3	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	128.	0.	1280.	224.	4
0	76	3	2	0.	0.	0.	0.	0.	0.	0.	0.	0.	288.	0.	2880.	200.	4
0	76	3	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	18.	0.	0.	165.	4
0	78	3	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.	0.	0.	141.	4
0	78	3	2	0.	0.	0.	0.	0.	0.	0.	0.	0.	288.	0.	2880.	200.	4
0	82	3	1	0.	17.	0.	0.	0.	0.	0.	0.	0.	6.	0.	0.	21.	4
0	85	3	1	273.	2384.	0.	0.	0.	0.	0.	0.	0.	262.	0.	0.	210.	4
0	86	3	1	4.	19.	0.	0.	0.	0.	0.	0.	0.	9.	0.	0.	47.	4
0	87	3	1	0.	98.	0.	0.	0.	0.	0.	0.	0.	18.	0.	0.	25.	4
0	88	3	1	0.	6.	0.	12.	0.	0.	0.	0.	0.	3.	0.	0.	5.	4
0	91	3	1	0.	0.	0.	13.	0.	0.	0.	0.	0.	2655.	0.	0.	4645.	4
0	92	3	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	19.	0.	0.	15.	4
0	93	3	1	120000.	420000.	0.	1090000.	0.	0.	0.	0.	0.	212808.	0.	498080.	234.	4
0	94	3	1	0.	0.	0.	0.	0.	0.	0.	0.	29640.	6706.	0.	14820.	70228.	2
0	95	3	1	0.	0.	0.	0.	0.	0.	100.	0.	4920.	1337.	0.	2460.	24980.	2
0	96	3	1	0.	0.	0.	10.	0.	0.	20.	0.	22740.	4285.	0.	11370.	63485.	2
0	98	3	1	0.	0.	0.	0.	0.	0.	0.	0.	5520.	890.	0.	2760.	14426.	2
0	100	3	1	0.	0.	0.	0.	0.	0.	0.	0.	720.	141.	0.	360.	10287.	2
0	173	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	12.	0.	0.	730.	2
0	174	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	38.	0.	0.	19196.	2
0	243	3	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.	0.	0.	46.	2
0	244	3	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.	0.	0.	1459.	2
12	1	1	2	0.	111538.	368.	13692.	0.	0.	0.	0.	0.	21900.	0.	93260.	1566.	4
12	1	1	1	0.	5035.	15.	704.	0.	0.	0.	0.	0.	1706.	0.	9328.	12176.	1
12	2	1	2	0.	35692.	0.	2462.	0.	0.	0.	0.	0.	6017.	0.	20900.	430.	4
12	2	1	1	0.	1368.	0.	97.	0.	0.	0.	0.	0.	406.	0.	2090.	2901.	1
12	13	1	1	0.	39.	0.	18.	0.	0.	0.	0.	0.	258.	0.	1712.	2469.	1
12	13	1	2	0.	11917.	0.	3583.	0.	0.	0.	0.	0.	3716.	0.	17120.	490.	4
12	14	1	1	0.	131.	0.	18.	0.	0.	0.	0.	0.	323.	0.	2228.	3093.	1
12	14	1	2	0.	29167.	0.	2833.	0.	0.	0.	0.	0.	5794.	0.	22280.	765.	4
12	15	1	1	0.	16200.	0.	1000.	0.	0.	10.	0.	0.	2766.	0.	10448.	608.	1
12	21	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	1596.	0.	15960.	35.	4
12	23	1	2	0.	6200.	200.	1600.	0.	0.	0.	0.	0.	4760.	0.	39600.	262.	4
12	23	1	1	0.	125.	7.	45.	0.	0.	0.	0.	0.	158.	0.	0.	1515.	4
12	24	1	1	0.	21.	0.	0.	0.	0.	0.	0.	0.	19.	0.	0.	182.	4
12	25	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	48.	0.	0.	462.	4
12	25	1	2	0.	0.	0.	0.	0.	0.	0.	0.	0.	1488.	0.	14880.	655.	4
12	30	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	808.	0.	3720.	1539.	4
12	31	1	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	4582.	0.	12540.	27161.	4
12	32	1	1	0.	13.	0.	0.	0.	0.	0.	0.	0.	3767.	0.	37500.	27766.	4
12	42	1	1	0.	150000.	0.	50000.	0.	0.	0.	0.	0.	120294.	0.	402960.	132.	4

Figure 5-4. Sample FORCEM Ammunition Consumption Report

5-4. AMOHIT PROGRAM. The POSTFOR Study has designed and implemented a program, called AMOHIT, to prorate the ammunition stocks destroyed by enemy fire among FORCEM weapons, to convert the losses from hundreds of pounds into numbers of rounds, and to add the rounds lost to the logistic losses reported in the FORCEM Ammunition Consumption (D36) Report. A sample runstream of the AMOHIT program is shown in Figure 5-5. The AMOHIT program reads from the FORCEM D36, R43 (FORCEM Air Deep Target Interdiction Report), and R52 (FORCEM Artillery Damage Report) as units 14, 13, and 12, respectively. A copy of the D36 file is also read from unit 11. From the system input stream the AMOHIT program reads a record for each weapon carried by each FORCEM vehicle to be played in the APP. Each record (lines 16-51 of Figure 5-5) contains the FORCEM asset number of the vehicle, the gun number (1 or 2) of the weapon, and the round weight used in FORCEM for the weapon. The first two of these entries are integer numbers, the third real, and these entries have free format. The AMOHIT program writes to unit 9 its revised D36 report, including only those weapons to be played in the APP.

```
 1:@FREE  9.
 2:@FREE  11.
 3:@ASG,T  11.,F///500
 4:@DELETE,C  71030434D36A.
 5:@ASG,UP  71030434D36A.,F///333
 6:@USE  9.,71030434D36A.
 7:@ASG,A  71-030434R43.
 8:@USE  13.,71-030434R43.
 9:@ASG,A  71-030434R52.
10:@USE  12.,71-030434R52.
11:@ASG,A  71-030434D36.
12:@USE  14.,71-030434D36.
13:@COPY  14.,11.
14:@USE  P.,UNCLASSIFIED*71APP.
15:@XQT  P:365AMOHIT
16:1  1  64.9
17:1  2  0.65
18:2  1  64.9
19:2  2  0.65
20:13  1  87.0
21:13  2  1.2
22:14  1  87.0
23:14  2  1.2
24:21  2  0.2
25:15  2  0.2
26:23  1  87.0
27:23  2  0.5
28:24  2  87.0
29:25  1  87.0
30:25  2  4.0
31:30  1  17.3
32:31  1  40.0
33:32  1  67.0
34:33  1  87.0
35:36  1  38.3
36:37  1  5.9
37:38  1  9.2
38:39  1  27.0
39:40  1  29.4
40:43  1  65.0
41:42  1  0.2
42:44  1  135.7
43:44  2  135.7
44:45  1  262.4
45:45  2  262.4
46:46  1  834.0
47:107  1  4324.3
48:108  1  10100.0
49:172  1  30.0
50:173  1  572.2
51:174  1  4544.4
52:@EOF
```

Figure 5-5. Sample Runstream of AMOHIT Program

5-5. COSAGE-APP LINKAGE PROGRAM (CALP). The existing CALP has been modified to write, on each type 6 record of the Ammo Expenditure Data File, by COSAGE posture, the percent of the FORCEM weapon's expenditures against this target that use this munition, in place of the expenditures per stylized day.

a. The CALP writes a partial Ammo Expenditure Data File (type 1, 3, 5, and 6 records) for direct-fire weapons to unit SIMU14 and a partial AMMO Expenditure Data File (type 1, 3, and 6 records) for indirect-fire weapons to unit SIMU16. A description of the records of the Ammo Expenditure Data File is given on pp. 79-82 of Reference 2. The CALP requires as input the same files as the existing CALP (for the existing APP) which is documented in Reference 1. The CALP can be executed for all COSAGE postures simultaneously, or one posture at a time, in which case a utility program is available from the existing APP to combine the resulting Ammo Expenditure Data Files from different postures. A sample of the partial Ammo Expenditure Data File for indirect-fire weapons resulting from the CALP is shown in Figure 5-6.

b. For example, the 45th line of Figure 5-6, a type 1 record, gives the nomenclature of the 8-inch howitzer. The next line, a type 3 record, gives the nomenclature of the first munition type, the M106 round, of this howitzer. The "10" in columns 33-34 of the type 3 record indicate a "business round" whose ammunition requirements are to be calculated from FORCEM rather than input as rated. The weight of the M106 round is 204 pounds. The next record, beginning with "6999" is a type 6 record indicating that of all the rounds fired in this COSAGE posture in shooter target combination #44, 9.24 percent were M106 rounds. The next record, a type 99 record (99 rather than 6 indicates the last record of this munition type), shows that of all the rounds fired in shooter-target combination #45 in this COSAGE posture, 4.29 percent were M106 rounds. The next three lines are similar to the type 3, 6, and 99 records just described, but for the next munition, the M509 round, of the 8-inch howitzer.

```
 1MORTAR, 60MM M224
 3HE M888                                    10          4.
 6999    32      100.
99999    33      100.
 1MORTAR, 81MM  XM252
 3HE M374                                    10          5.
 6999    38       66.18
99999    39       28.01
 3HE M374                                    10          5.
 6999    38       33.82
99999    39       71.99
 1MORTAR, 4.2 IN
 3HE M329                                    10          8.
 6999    34      100.
99999    35      100.
 1HOWITZER, 105MM
 3HE M-1                                     10         50.80
 6999    40      100.
99999    41      100.
 1HOWITZER, 155MM M109 SERIES AND M198
 3HE M107                                    10         94.60
 6999    42       12.17
99999    43        4.63
 3HE DPICM M483                              10        102.60
 6999    42       13.21
99999    43       17.54
 3HE M107                                    10         94.60
 6999    42        9.65
99999    43        8.78
 3HE DPICM M483                              10        102.60
 6999    42       14.98
99999    43       20.04
 3HE M107                                    10         94.60
 6999    42        5.42
99999    43        4.14
 3HE DPICM M483                              10        102.60
 6999    42       35.38
99999    43       33.36
 3HE M107                                    10         94.60
 6999    42        0.51
99999    43        0.85
 3HE DPICM M483                              10        102.60
 6999    42        8.68
99999    43       10.65
 1HOWITZER, 8IN SP
 3HE M106                                    10        204.
 6999    44        9.28
99999    45        4.29
 3HE DPICM M509                              10        206.50
 6999    44       87.25
99999    45       89.95
 3HE RAP M650                                10        200.
 6999    44        3.50
99999    45        5.76
 1MLRS
 3HE-DPICM                                   10        600.
 6999    46      100.
99999    47      100.
```

Figure 5-6. Sample CALP Results

5-6. PFDATA PROGRAM. The POSTFOR Study has developed a program, called PFDATA, to prorate the FORCEM expenditures of ammunition among the several APP weapons that may be "rolled up" into a single FORCEM weapon. The prorating is proportional to the deployed densities, by APP time period (days 1-15, days 16-30, days 31-60, days 61-90, days 91-120, days 120-150, and days 151-180), of the APP weapons, as input on the type 2 records of the Ammo Expenditure Data File (described in pp 79-80 of Reference 2).

a. The PFDATA program reads the Ammo Expenditure Data File from unit 10, and writes a revised Ammo Expenditure Data File, with its type 2 records containing extra data, to unit 11. A sample runstream of the PFDATA program is shown in Figure 5-7, and a sample of the revised Ammo Expenditure Data File is shown in Figure 5-8. From the system input stream the PFDATA program reads:

(1) A record (line 10 of Figure 5-7) containing the number of shooter-target combinations (known as ESD in the terminology of the existing APP) to be read from the ESDMAP file; this integer number should end in column 5 of the record.

(2) The ESDMAP file--a sample ESDMAP file is shown in Figure 5-9. This file, in the same format as used by the existing APP, contains an initial line that is skipped; followed by one line for each ESD (lines 2-49 of Figure 5-9), containing the ESD number, the APP number of the Blue shooter (between 1 and 30), and the APP Red target group (between 1 and 6) as free-formatted integers; followed by two lines (lines 50-51 of Figure 5-9) that are skipped.

(3) The TRMAPS file, which is described in pp 17-19, 47 of Reference 2. A sample of this file is shown in Figure 5-10. Note that the Blue shooter mapping numbers beginning on line 23 of the TRMAPS file are the FORCEM asset numbers of the Blue equipment; for example, small arms would be 42 and divisional artillery between 43 and 50. These integer numbers are free-formatted, but must begin on line 23 of the TRMAPS file. The first 21 lines of the TRMAPS file are skipped by the PFDATA program.

```
 1:@FREE 10.
 2:@FREE 11.
 3:@USE 11.,71PFDA84M/RK/WK.
 4:@DELETE,C 11.
 5:@ASG,UP 11.
 6:@ASG,A 71PFD84M/RK/WK.
 7:@USE 10.,71PFD84P/RK/WK.
 8:@USE P.,UNCLASSIFIED*71APP.
 9:@XQT P.38SPFDATA
10:    48
11:@ADD P.ESDMAP/84P
12:@ADD P.TRMAPS/84P
```

Figure 5-7. Sample Runstream of PFDATA Program

```
1          42    1    2    4   13   14   15   16   24   25   29   30   31   32   33
2          40   43   44   45   46  110  111
3        1TANK GUN, 105MM (M11)
4          2    333.      111.      111.       0.        0.        0.        0.      0.01  1100.0 85.0 85.0 75.0 75.0 85.0 85.0
5        3APFSDS M833                          10                41.90
6       E67901 T13374
7          4   .67   1.0
8          5         3      29.84      32.37      36.91      35.31    2.
9       6999         7      100.0      100.0      100.0      100.0     1
10      6999         8       20.0       10.0       12.0       10.0     2
11      99999        9      100.0      100.0      100.0      100.0     5
12       3HEAT M456                           10                50.80
13      E29200 T13374
14         4   .33   1.0
15         5         3      17.74      17.63      18.00      17.93    1.
16      99999        8       80.0       90.0       88.0       90.0     2
17       1HOWITZER, 8 INCH (SP)
18         2    444.      111.      111.      111.       0.        0.        0.      0.01 45100.0100.0100.0100.0100.0100.0100.0
19       3HIGH EXPLOSIVE M106                  10                197.80
20      E29300 K56981
21         4  1.0  .013
22      99999   45       21.5       33.8       1.6       17.5      6
23       3HE RAP M650                         10                197.80
24      E66600 K56981
25         4  0.0  .851
26      99999   45       78.5       66.2       98.4       82.5      6
27       1HOWITZER, 8 INCH (SP)
28         2    444.      111.      111.      111.       0.        0.        0.      0.02 45100.0100.0100.0100.0100.0100.0100.0
29       3HE DPICM M509                        10                206.50
30      E67000 K56981
31         4  1.0  .136
32      99999   45      100.0      100.0      100.0      100.0     6
33      99999999999999999999999999999999
```

Figure 5-8. Sample Revised Ammo Expenditure Data File

1		NOT USED		
2	1	1	1	1
3	2	16	6	6
4	3	1	6	6
5	4	3	1	1
6	5	3	2	2
7	6	3	5	5
8	7	2	1	1
9	8	2	2	2
10	9	2	5	5
11	10	3	1	1
12	11	3	2	2
13	12	3	5	5
14	13	9	1	1
15	14	9	5	5
16	15	6	1	1
17	16	6	2	2
18	17	6	5	5
19	18	7	1	1
20	19	7	5	5
21	20	8	1	1
22	21	8	2	2
23	22	8	5	5
24	23	5	1	1
25	24	5	2	2
26	25	5	5	5
27	26	11	6	1
28	27	4	1	5
29	28	4	2	1
30	29	4	5	2
31	30	10	1	5
32	31	10	6	6
33	32	12	1	1
34	33	12	6	6
35	34	13	1	1
36	35	13	6	6
37	36	14	6	6
38	37	15	6	6
39	38	12	1	1
40	39	12	6	6
41	40	17	1	1
42	41	17	6	6
43	42	18	1	1
44	43	18	6	6
45	44	19	1	1
46	45	19	6	6
47	46	20	1	1
48	47	20	6	6
49	48	1	1	1
50		NOT USED		
51		NOT USED		

Figure 5-9. Sample ESDMAP File

```
 1            NOT USED
 2            NOT USED
 3            NOT USED
 4            NOT USED
 5            NOT USED
 6            NOT USED
 7            NOT USED
 8            NOT USED
 9            NOT USED
10            NOT USED
11            NOT USED
12            NOT USED
13            NOT USED
14            NOT USED
15            NOT USED
16            NOT USED
17            NOT USED
18            NOT USED
19            NOT USED
20            NOT USED
21            NOT USED
22       22  6  4  57  8
23        1   2   3   5   14  15  16  17  25  26  30  31  32  33  34
24       41  43  44  45  46 110 111  99  99  99  99  99  99  99  99
25            NOT USED
26            NOT USED
27            NOT USED
```

Figure 5-10. Sample TRMAPS File

b. The PFDATA program requires that the Ammo Expenditure Data File that it reads has in column 68 of each type 2 record (lines 4, 18, 28 of Figure 5-8) the FORCEM gun type (1 or 2) of the APP weapon. The PFDATA program writes the FORCEM equipment asset number to columns 69-71 of each type 2 record, the Red APP target group (1-6) to column 55 of each type 6 and 99 record (lines 9-11, 16, 26, 32 of Figure 5-8), and this APP weapon's percentage of its FORCEM weapon's deployed density, by APP time period (of which there are seven) to columns 72-106 of each type 2 record of the output Ammo Expenditure Data File. The PFDATA program also writes, at the beginning (lines 1-2 of Figure 5-8) of the revised Ammo Expenditure Data File, the FORCEM asset number of each Blue shooter type.

5-7. REPGEN PROGRAM. A FORCEM ammunition report generator program, called REPGEN, has been adapted from the existing APP Report Generator by the POSTFOR Study. The REPGEN program produces essentially the same reports as the existing APP, based on FORCEM results. The REPGEN program also permits the reporting of rates for munitions not played in FORCEM, using the same methodology as the existing APP. To the ammunition consumption occurring in FORCEM the REPGEN program adds sea losses, that is, ammunition destroyed during transportation to the theater of operations. Sea losses are based on factors that are input by APP time period; the consumption of a munition during each APP time period is multiplied by the period's sea loss factors to yield sea losses. For those munitions played in FORCEM, no factors other than sea losses are added to the consumption in the FORCEM. The REPGEN program uses the prorating percentage computed by the CALP and PFDATA programs and recorded in the revised Ammo Expenditures File, to allocate the ammunition consumption by a FORCEM weapon among its constituent APP munitions.

a. The REPGEN program writes the Rates Report, Three-day Pile Report, and Distribution of Requirements Report (to unit 6) and the Seven file (to unit 7) described in Reference 2, pp 82-83 and 93-102. In the Distribution of Requirements Report, rounds consumed in rear area security, weapon registration, and function checks are included in the first (FAC-IN) line of each weapon. Expenditures in FORCEM of nondivisional missiles and air defense weapons and of general support artillery are reported in the fourteenth (HI+GS) line.

b. The REPGEN program reads the FORCEM Ammunition Consumption (D36) Report from unit 10, the FORCEM Ammunition Fired (D37) Report from unit 11, and the Ammo Expenditure Data File both from unit 8 and from unit 9. A sample runstream for the REPGEN program is shown in Figure 5-11. From the system input stream the REPGEN program reads the following.

(1) One line (line 31 of Figure 5-11) of four free-formatted integers containing the number of days of combat simulated (from D-day on); the number of hours to be skipped before FORCEM H-hour, D-day; the number of Blue APP weapon types (cannot exceed 30); and the number of Red target groups (cannot exceed 6).

```
 1:@RUN,/TPR D171RG,F1385T5438Z,SECRET,020,5000
 2:@QUAL UNCLASSIFIED
 3:@DELETE,C 717TEST/  /  .
 4:@DELETE,C 71REPORTEST/  /  .
 5:@MSG,N THE FOLLOWING FILE WILL CONTAIN THE RATES(ONLY RATES, NO TONS,
 6:@MSG,N QUANTITIES, ETC) AND IS THE BASIS FOR ALL TAPES LEAVING THE
 7:@MSG,N AGENCY IN RESPONSE TO OCSOPS REQUESTS.
 8:@USE 7.,717TEST'  /  .
 9:@ASG,UP 7.
10:@FREE  8.
11:@FREE  2.
12:@FREE  3.
13:@MSG,N THE FOLLOWING FILE WILL CONTAIN THE THREE PRIMARY REPORTS
14:@MSG,N WHICH ARE THE RESULTS OF THE APP.  THEY ARE THE REQUIREMENTS
15:@MSG,N REPORT, THE 3 DAY PILES REPORT, AND THE DISTRIBUTION OF
16:@MSG,N REQUIREMENTS REPORT.  THE REQUIREMENTS REPORT IS
17:@MSG,N GENERALLY PUBLISHED IN THE STUDY REPORT.
18:@ASG,UP 71REPORTEST/  /  .,///2000
19:@USE REPORT.,71REPORTEST/  /  .
20:@ASG,T 3.,///500
21:@ASG,T 2.,///200
22:@ASG,T 8.
23:@USE  9.,71PFDA84M/  .
24:@USE 10.,7103043%D36A/  /  :
25:@USE 11.,71-03043%D37/  /  :
26:@COPY 9.,8.
27:@USE  X.,UNCLASSIFIED*71APP.
28:@BRKPT PRINT$/REPORT
29:@TITLE FORCEM$APP,TEST,4$MAR$86
30:@XQT  X.385REPGEN
31:    20   240    21     6
32:PERSON 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
33:TANKS  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
34:ICV    0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0
35:APC    0 0 0 0 0 0 0 1 0 0 1 1 1 1 1 1 1 1
36:OTHER  0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
37:OTHERS 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0
38:               9
39:1            TRP-PE     1 PERSON
40:2            FPV-PE     1 PERSON
41:3            TRP-AR     5 ICV APC TANKS OTHER OTHERS
42:4            M61-PE     1 PERSON
43:5            M61-LA     4 ICV APC OTHER OTHERS
44:6            M61-TK     1 TANKS
45: 7           M51-PE     1 PERSON
46: 8           M51-LA     4 ICV APC OTHER OTHERS
47: 9           M51-TK     1 TANKS
48:@ADD X.ISD
49:@ADD 71APPC/  .TITLE/UNCL
50:@ED,R 717TEST/  /  .
51:LNP 100
52:OMI
53:@BRKPT PRINT$
54:@FREE,R REPORT.
55:@SYM,U REPORT.
56:@FIN
```

Figure 5-11. Sample Runstream of FORCEM Ammunition Report Generator

(2) For each Red target group one line (lines 32-37 of Figure 5-11) containing the six-character name of the target group and 18 binary integers indicating whether a Red target category belongs to this group, formatted A6, 18I2. Entries are one (1) for a category included in the group, zero (0) for a category not in this group. Red target categories are numbered as follows:

1 - Troops
2 - Tanks
3 - Helicopters
4 - Antitank/mortars
5 - Artillery
6 - Tactical aircraft
7-18 - APCs by type

(3) One line (line 38 of Figure 5-11) containing the number of Blue shooter-Red target group combinations (ESD) to be used, as a free-formatted integer (cannot exceed 72).

(4) A line for each ESD (lines 39-47 of Figure 5-11), containing, in column 21, the number of Red target groups belonging to this ESD (between 1 and 6), and the names of these target groups, beginning in column 23, separated by a single blank.

(5) The ISD file, which contains one line for each of 33 time periods, containing, in column 2, a sample criterion number between 1 and 4, as described in Reference 2, pp 78 and 88. Time periods 1-30 are the 3-day periods from D-day through D+89; periods 31-33 are the three 30-day periods from D+90 through D+179.

(6) The PF.TITLE file, described in Reference 2, pp 79 and 89, containing titles, sea loss factors, and lines per page and total pages for each APP output report.

c. Certain fields of the Ammo Expenditure Data File are used differently by the REPGEN program than they were by the existing APP, described in Reference 2.

(1) In the "type 2" records, i.e., the records beginning with a "2" in column 2 (lines 4, 18, 28 of Figure 5-8), column 68 is used to identify which of the two possible weapons (1 or 2) carried by the FORCEM equipment corresponds to this APP weapon.

(2) Columns 69-71 of the type 2 records contain the FORCEM asset number of the equipment carrying this weapon (in integer I3 format).

(3) Columns 72-106 of the type 2 records (lines 4, 18, 28 of Figure 5-8) contain seven decimal numbers, formatted 7F5.2, indicating this weapon's percentage of the density of deployed weapons combined into this weapon's FORCEM weapon, for each of the following seven reporting periods: days 1-15, 16-30, 31-60, 61-90, 91-120, 121-150, and 151-180. The PFDATA routine, described above, can be used to insert the data in columns 69-106 of the type 2 lines.

(4) For a munition computed by the "normal method," i.e., having zero in column 34 of the type 3 record (lines 5, 12, 19, 23, 29 of Figure 5-8) columns 3-7 of the type 4 record (lines 7, 14, 21, 25, 31 of Figure 5-8), contain not the log loss factor, but rather the fraction of the FORCEM weapon's zeroing expenditures that are to be attributed to this munition. Thus, if a weapon fires only one munition type, columns 3-7 of the type 4 record should contain 1.0.

(5) For a munition computed by the normal method, columns 8-12 of the type 4 record contain not the H&I factor, but the fraction of this weapon's general support expenditures in FORCEM that should be attributed to this munition. Again, if a weapon fires only one munition type, columns 8-12 of the type 4 record should contain 1.0.

(6) The "scale factor" in columns 63-67 of the type 4 record is not used by the REPGEN program.

(7) The data in the type 5 record (lines 8, 15 of Figure 5-8) are not used.

(8) Columns 11-50 of the type 6 or 99 record (lines 9-11, 16, 22, 26, 32 of Figure 5-8) contain, for each of the four COSAGE postures--Blue delay, Blue defend, static, and Blue attack--the percentage of the rounds fired by this FORCEM weapon at this target group that should be attributed to this munition. Thus, a weapon that fires only one munition type at a particular target group should have 100. in each of columns 11-20, 21-30, 31-40, and 41-50 of the type 6 or 99 record for that target group.

5-8. OPERATIONAL TESTING. A test of the FORCEM Ammunition Postprocessor was conducted using the results of a FORCEM run simulating 30 days of combat in Europe. The inputs to the FORCEM simulation were essentially those of the OMNIBUS-85 Study, with the addition of ammunition "add-on factors" for both sides. The results of this operational test, documented separately in Reference 3, are different in many respects from ammunition rates obtained in earlier studies that used the CEM. Paragraph 2-7c lists some limitations of the operational test. The operational test illuminates certain important features of the FORCEM Ammunition Postprocessor.

a. The FORCEM Ammunition Postprocessor is quite sensitive to the number of rounds fired by each weapon in FORCEM, and is not sensitive to the number of rounds fired in COSAGE. Thus if the attrition calibration algorithm (ATCAL) in FORCEM determines that a particular weapon fires very little against those combinations of targets that occur in the theater conflict simulated, the resulting ammunition rates from the FORCEM Ammunition Postprocessor for that weapon will be correspondingly low, regardless of how much the weapon fired in the COSAGE. Hence it is important to the FORCEM Ammunition Postprocessor that the ATCAL faithfully reproduce and accurately extrapolate the expenditures by each weapon in the COSAGE. The existing (CEM) APP, on the other hand, is quite sensitive to the expenditures by each weapon in the COSAGE, and is not at all sensitive to the expenditures by each weapon in the CEM.

b. Before operating FORCEM, the PHASEONE (ATCAL calibration from COSAGE) input file should be examined to ensure that all the expected weapons appear as shooters in the calibration from COSAGE and that each of the weapons that appears as a shooter has a weapon/ammo asset of the proper type (1 or 2) in the FORCEM ASSET input file. When a short run of the FORCEM has been made, the FORCEM Ammunition Expenditure Report (D37) can be used to verify that the weapons for whom ammunition rates are to be calculated are indeed firing in FORCEM.

c. The numbers of weapons in theater at D-day and in deploying units, for input in the type 2 lines of the Ammo Expenditures File, should be obtained from the FORCEM inputs, rather than read from the FORCEM Loss and Consumption Report (R64). The "authorized" field of the R64 report can include equipment not in maneuver or artillery battalions, such as equipment pools. Those who prepare the FORCEM inputs normally can provide accurate counts of the authorized levels of each type of equipment in deployed and deploying units. When preparing inputs to FORCEM, units such as equipment pools that contain weapons can be assigned a national partition other than 1 (US), so that the authorized weapons of these units are not reported with the authorized US weapons in the FORCEM R64 report. On the other hand, the national partition assigned to a support complex containing ammunition should be as accurate as possible, so that US ammunition destroyed in support complexes and convoys can be captured accurately by the FORCEM Ammunition Postprocessor.

5-9. SUMMARY. The POSTFOR Study has developed a new methodology for calculating ammunition requirements and reporting them in the same formats as the existing APP. Chapter 5 has described the rationale for this methodology and the computer routines used in this methodology, has provided instructions for using these routines, and has discussed the operational testing of these routines.

CHAPTER 6

LONG-TERM IMPROVEMENTS

6-1. INTRODUCTION. This chapter presents some recommendations for long-term methodology improvements that are beyond the scope of the POSTFOR Study, but would enhance the quality of the product of one or more of the FORCEM postprocessors. The first recommendation is for a change to FORCEM. The remainder of the recommendations are related to the interface between FORCEM and the force roundout postprocessor.

6-2. FORCEM WEAPONS CONSTRAINTS. The quality of the product of the FORCEM ammunition postprocessor would be significantly enhanced if the present FORCEM constraints on the number of weapon types that can be represented in the division attrition process could be relaxed.

a. The FORCEM code permits, among the US and its allies, 8 types of artillery, 5 types of helicopters, 1 type of small arms, and 12 types each of tanks, light armor, and antitank/mortars. Each of these equipment types can fire two types of munition. Among these 50 possible types must be found slots for division air defense weapons and mines, if they are to be represented. The result of these FORCEM constraints is that FORCEM users must combine similar weapon types into a single, "rolled-up" weapon.

b. When weapons of non-US allies are combined, the accuracy of the attrition computations is degraded, because the vulnerability and effectiveness of the component weapons have to be averaged somehow, and thus the entire outcome of the campaign simulation is affected. When US weapons have to be rolled-up, in addition to the effect on the attrition computations, there is a problem in the FORCEM ammunition requirements postprocessor in determining which of the rolled-up weapons fired the rounds and which of the rolled-up munitions were fired.

c. This problem of the ammunition postprocessor could be significantly alleviated if the FORCEM and ATCAL routines were modified to handle four or five, rather than two, munition types per division weapon, thus permitting separate accounting, for example, of the different weapons carried by the same Bradley fighting vehicle, of the different projectiles (such as high explosive, improved conventional munition, Copperhead, scatterable mines, chemical, etc.) fired by the same artillery tube, and of the different weapons (e.g., rifles, machineguns, mines, grenades, Stinger, etc.) that may be combined in the small arms category.

d. Providing more munitions per equipment type does not, however, solve the problem of computing attrition in battles with rolled-up weapons as participants; that problem can best be solved by expanding the possible equipment types that can participate in the FORCEM division battles.

6-3. FASTALS. In the long term, the methodology of FASTALS and the modeling of CSS in FORCEM should be examined to determine how best to make FASTALS take advantage of the more detailed information available from FORCEM than is available from CEM. (See also paragraphs 7-1b(3) and 7-1d(5) and Reference 4).

a. FORCEM represents certain aspects of a campaign that are not represented in CEM. For example, FORCEM determines the transportation requirements--how much has to be moved how far--for each support complex each cycle; FORCEM also calculates the quantity of trucks, trains, and barges used to meet the transportation requirements. FORCEM calculates the quantities of materiel and personnel that must be processed through the ports. FORCEM calculates the quantity of equipment suffering combat damage and needing repair, not only for tanks, helicopters, and light armor, as CEM does, but for artillery, trucks, recovery vehicles, antitank/mortar weapons, and air defense weapons. FORCEM also applies attrition to support units, convoys, and ports.

b. The more detailed information that is available from FORCEM could be used to improve the accuracy of a support forces requirements model. In particular, determining the required numbers of truck companies should more accurately reflect the results of a FORCEM campaign simulation if the transportation requirements come from FORCEM rather than being reconstructed by FASTALS; and the requirements for repair of trucks and artillery will be more consistent with FORCEM if they are read from FORCEM results than if the repair requirements are recalculated from tables in FASTALS. In general, whenever workloads affecting the support force roundout are calculated in FORCEM but ignored and recalculated by FASTALS based on less information than was used in FORCEM calculation, the quality and consistency of the force roundout product can be improved by using FORCEM-generated workloads and deleting the recalculation of workloads in FASTALS. This presumes that workloads can be computed in FORCEM with enough detail and accuracy to satisfy the logistics community, which is the consumer of the force roundout product. Even if the force roundout experts prefer the way a workload is calculated in the FASTALS Model to the FORCEM calculation of the same workload, it is better to install the preferred calculation in FORCEM, where possible, than to leave the two calculations inconsistent.

c. As currently designed, FORCEM represents the combat units, combat support units, and those CSS units that directly affect the combat and combat support functions. These probably constitute less than half the items that generate requirements for CSS in the theater of operations. Thus a possibility exists of unrealistic FORCEM results if all the capabilities of a particular CSS function (e.g., transportation) are used in a FORCEM simulation. To prevent this possibility with the current FORCEM design, the CSS capabilities input to FORCEM must be reduced to anticipate the requirements for CSS that will be generated by factors not played in FORCEM.

d. A more satisfactory long-term approach, consistent with the intent of representing CSS in FORCEM, is to include in FORCEM more of the items that generate requirements for CSS. This amounts to incorporating FASTALS-like computations into FORCEM. For those CSS functions currently treated in the FORCEM, computations can be incorporated into the FORCEM for workloads and productivity. The resulting data can be used as inputs to FASTALS computations. For those CSS functions not currently treated in FORCEM (such as engineer construction), input workload rates would be necessary.

e. To avoid overburdening the unit data structure within FORCEM with the large number of Table of Organization and Equipment (TOE) units that FASTALS-like computations could generate, such units would be intro- duced by accumulating their assets into the existing FORCEM support complex (SUPCOM) units--for TOE units providing CSS capabilities--or into headquarters units--for other TOE units. The intent is to take account of such TOE units in terms of their capabilities (for CSS units) and of the burden they impose on the CSS structure.

f. Even though the FASTALS-generated TOE units could be combined in FORCEM, the FASTALS computational approach would necessitate maintaining bookkeeping on the numbers and types of TOE units and to whom they are assigned. Incorporating FASTALS-like computations into FORCEM will add significantly to the complexity and running time of FORCEM, but it could significantly reduce the computations required of the force roundout postprocessor.

g. Finally, the fidelity of the force roundout would be enhanced if FORCEM could distinguish CSS capabilities by national partition at all echelons. The current FORCEM logic aggregates the CSS from all national partitions, at echelons above corps. The problem is that in studies such as TAA, for which the campaign should be simulated with American CSS unconstrained in FORCEM, the current FORCEM forces the CSS of non-US allies to be unconstrained as well. This difficulty can be overcome by partitioning the CSS capabilities at all echelons.

6-4. SUMMARY. This chapter suggests improvements to the FORCEM postprocessor methodologies that are beyond the scope of the POSTFOR Study. First, the quality of ammunition postprocessor results could be enhanced by permitting more weapon types in divisions in FORCEM. Second, the modeling of CSS in FORCEM and FASTALS can be refined to enhance consistency between FORCEM and FASTALS and to make use in FASTALS of the CSS workloads computed by FORCEM.

CHAPTER 7

ESSENTIAL ELEMENTS OF ANALYSIS (EEA)

7-1. EEA. The following subparagraphs provide the POSTFOR Study response to each EEA.

a. What data are already available from FORCEM output reports, and what can be generated through the modification of the FORCEM and the creation of new reports from FORCEM?

(1) All of the data required by the postprocessors under consideration either are already available from FORCEM output reports or can be generated through the modification of FORCEM and the creation of new reports from FORCEM, with the exception of FEBA displacement data, for which a surrogate measure must be used.

(2) In the course of the POSTFOR Study, several new FORCEM reports were created, and existing reports modified, to meet the data requirements of the postprocessors. The FORCEM Loss and Consumption Report (R64) was created for use by the force roundout and WARF postprocessors; the CORF Issue Report (R65) for the CORF factors postprocessor; the Indirect Fire Ammunition Report (R67) for the WARF postprocessor; and two new FORCEM ammunition consumption reports for the ammunition requirements postprocessor. Further, modifications to the FORCEM logic of equipment repair and replacement were made to meet the requirements of a CORF factors analysis, but these modifications are not routinely activated for campaign simulations other than CORF analyses. Substantial changes to the model code of FORCEM were necessary to support the new methodology of determining ammunition requirements, that is, to include the calculation of all the categories of noncombat consumption of ammunition in FORCEM and to report all categories of ammunition consumption by weapon type.

(3) FORCEM does not have a well-defined, continuous FEBA that runs from one end of the theater to the other. Indeed, FORCEM permits units of either side to be bypassed, encircled, and engaged by the enemy from any direction; so the "FEBA displacement" reported by CEM has no meaning in the context of FORCEM. Instead, the average distance moved by FORCEM online corps in the FASTALS sector is used as a surrogate for FEBA displacement. However, designers and users of the FASTALS, which is the only postprocessor to use FEBA displacement data, should be aware that FORCEM cannot provide FEBA results equivalent to those reported by CEM, and should investigate alternative means of determining when a particular zone or sector of the theater of operations has been lost to an advancing enemy.

b. Which existing postprocessors for CEM should be retained (and possibly modified), and which should be replaced?

(1) All the existing CEM postprocessors should be retained, with such modifications as necessary to permit them to accept campaign simulation

data in FORCEM report formats, with the exception of the existing APP, which should be replaced.

(2) All the existing postprocessors under consideration, including the APP, could be modified with little difficulty to accept campaign simulation results in FORCEM, rather than CEM, report formats. (The existing APP would also require some additions to the FORCEM logic and reports.) With the phasing in of FORCEM, it is appropriate to replace the existing APP for the following reasons. First, in order to represent accurately the impact of noncombat consumption of ammunition, such as logistic losses, zeroing, functional checks, etc., this consumption should be added to transportation workloads and deducted from ammunition stocks in FORCEM, rather than added after the campaign simulation, as the existing APP does. Second, FORCEM's more detailed representation of rear areas and support units which are subject to attrition should permit a more realistic, accurate accounting of such categories as logistic losses and expenditures for rear area security than is possible by applying a factor in a postprocessor. Finally, because the existing APP ignores the consumption reported by CEM, the ammunition consumption reported by the existing APP in a study may significantly exceed the ammunition used in the study. If FASTALS is executed using the ammunition consumption reported by this CEM simulation, FASTALS may report a requirement for ammunition handling companies that is quite insufficient for the possibly greater ammunition consumption reported by the existing APP for the same study. The new methodology developed for determining ammunition requirements ensures consistency between FORCEM and its postprocessor.

(3) In the long term, the methodology of FASTALS and its linkage to FORCEM should be examined to determine how FASTALS can be made to take advantage of the more detailed information available from FORCEM than from CEM, such as transportation workloads, repair workloads for equipment other than tanks and light armor, workloads of ports and medical units, attrition of CSS units, and interdiction of friendly lines of communication (LOC). This would certainly require modification of FORCEM, to report the CSS functions in more detail, as, for example, discussed in paragraph 10 of Reference 4. FORCEM reports should include the distance between FORCEM support complex (SUPCOM) units; the requirements for transportation of US ammunition, fuel, replacement or filler equipment, and replacement or filler personnel by originating unit and destination unit, by FORCEM asset number, and by time period; the numbers of combat-damaged equipment entering a SUPCOM at echelons above divisions (EAD) for repair, by headquarters of the SUPCOM, by nationality of the owning unit, by FORCEM equipment asset number, by direct support versus general support, and by time period; the numbers of wounded US personnel entering a SUPCOM at EAD for medical treatment, by headquarters of the SUPCOM, by nationality of the owning unit, by FORCEM personnel asset number, and by time period; and the numbers of personnel onhand in US units, by headquarters of the unit, by FORCEM asset number, and by FASTALS time period. The linkage from FORCEM to FASTALS would also require changes to accept these data; and FASTALS would probably require modification to make use of these additional inputs from FORCEM, although it might be possible to determine the support unit equivalents required for the FORCEM workloads before executing FASTALS and

to input these unit equivalents to FASTALS as some type of offsets. Designing such revisions to the FASTALS linkage is a major effort in itself, requiring the expertise of the FASTALS functional area analysts and demanding close coordination with the logistics community, to ensure acceptance by those who use the results of FASTALS.

c. What computations performed in a postprocessor of the CEM should be performed in the FORCEM itself?

(1) The computation in the existing APP of all categories of ammunition consumption except sea losses should be performed in FORCEM itself.

(2) The attrition calibration (ATCAL) methodology used in FORCEM permits the accounting of the rounds fired by each type of weapon at each type of target in the division engagements, and of the number of rounds fired by each type of air defense weapon and by each type of general support artillery. Onboard losses of ammunition when a vehicle is hit by enemy fire are also represented in FORCEM, and can be ascribed in FORCEM to the type-weapon suffering the loss. Consequently, for the three reasons given in paragraph 7-1b(2), the computation of ammunition requirements, except for sea losses, should be performed in FORCEM. Sea losses, since they occur outside the theater of operations and are not affected by the campaign simulation, can most appropriately be represented outside of FORCEM.

d. Where the FORCEM and a retained postprocessor both represent an activity, with perhaps differing methodologies, what can be done to achieve consistency?

(1) Regarding the computation of ammunition requirements, consistency can be achieved by performing the computation of all but sea losses in FORCEM and removing from the postprocessor all computation of requirements that are computed in FORCEM, thus eliminating the differing methodologies.

(2) Regarding the representation of tactical aircraft in both the campaign simulation model and the air defense missile postprocessor, consistency can be achieved by calculating air defense expenditures in FORCEM, thus eliminating the need to repeat the modeling of tactical air sorties in a postprocessor.

(3) Regarding the replacement of damaged equipment while it is in repair, consistency can be achieved by modifying FORCEM to make it consistent with the CORF Factors Postprocessor.

(4) Concerning the stratification of casualties, consistency can be improved by revising the casualty stratification process to take account of whatever degree of stratification is reported by FORCEM.

(5) The CSS of both FORCEM and FASTALS should be examined to determine how consistency between FORCEM and FASTALS can be achieved in the representation of those CSS functions modeled in FORCEM. Examples of inconsistencies in the representation of CSS functions include the following. (Some remedies are proposed in paragraph 9 of Reference 4.)

(a) The FASTALS concept of three sectors and of logical/physical regions is inconsistent with the FORCEM US corps regions and command hierarchy.

(b) FORCEM does not compute requirements for and represent transportation of classes of supply other than ammunition, fuel, and repair parts, while FASTALS treats 12 classes of supply.

(c) In transportation, FORCEM requires at least one full 12-hour cycle for every trip, one full 12-hour cycle is used for loading, and at least one 12-hour cycle is wasted for delivering to a destination unit that is moving.

(d) FORCEM does not represent the transportation of replacement equipment, as FASTALS does.

(e) FORCEM does not represent intratheater airlift, and the assignment of transportation modes (truck versus rail versus barge versus pipeline) has not been consistent with FASTALS.

(f) In FORCEM the repair of operational failures is not consistent with FASTALS, and FORCEM does not represent requirements for repair of equipment not played in FORCEM.

(g) FORCEM does not represent the medical treatment of enemy prisoners or civilian internees.

(h) FORCEM does not properly represent host nation support (HNS) capabilities. If the HNS units are input to FORCEM as US units, they generate US losses and requirements for US support.

(6) To ensure consistency between FORCEM and the support force requirements generated by FASTALS, the FASTALS functional area experts must ensure that the inputs to FORCEM concerning the capabilities and productivity of support units are in close agreement with the assumptions of the force roundout postprocessor. When operating FORCEM with CSS constrained, the capabilities of CSS units, such as the capacities of ports, hospitals, maintenance shops, and pipelines, must be provided as input to FORCEM. If the CSS capabilities are not consistent with the assumptions of FASTALS, then the execution of FASTALS will produce a CSS structure that may not agree with the CSS structure assumed as input to FORCEM.

7-2. SUMMARY. This chapter has provided the response of the POSTFOR Study to the EEA provided in the tasking directive of the study (Appendix B).

APPENDIX A

STUDY CONTRIBUTORS

1. STUDY TEAM

a. Study Director

Dr. Ralph E. Johnson, Research and Analysis Support Directorate

b. Team Members

Mr. Peter C. Byrne
Ms. Renee S. Carlucci
Dr. James Metzger

c. Other Contributors

Mr. Norig G. Asbed
Mr. Raymond G. McDowall
Mr. Arthur W. Paarmann

2. PRODUCT REVIEW BOARD

Ms. Louise L. Cox, Chairman
Mr. Frank O. Gould
LTC Daniel R. Noonan, Jr.
Ms. Sharilyn Fabian

APPENDIX B

STUDY DIRECTIVE

CSCA-ASD

25 JAN 1985

MEMORANDUM FOR ASSISTANT DIRECTOR, AS

SUBJECT: Postprocessors for FORCEM (POSTFOR) Study

1. PURPOSE. This directive provides tasking for a study to ensure that postprocessors for the Force Evaluation Model (FORCEM) are available for its use as the primary model for force-level studies performed by the US Army Concepts Analysis Agency (CAA).

2. BACKGROUND.

a. Over the years that the Concepts Evaluation Model (CEM) has been used in capabilities, force planning, and requirements studies, various postprocessor models have been developed and/or employed to produce analysis data appropriate to study needs. These postprocessor models perform aggregation or disaggregation of CEM output data, or generate information about activities not represented in CEM.

b. FORCEM is a fully-automated computer model treating combat, combat support, and combat service support (CSS) in a theater. It has been developed and tested over the period Mar 82 through Dec 84. It is transitioning to operational use in CY 85--as the primary production model for the OMNIBUS 85 Study; and as an alternate model in parallel with CEM for the TAA-92 Study.

c. Methods must be developed for obtaining the necessary data for studies applying FORCEM. Because FORCEM includes more detailed representations of battlefield functions (especially of CSS) than does CEM, some of the necessary data for studies may be obtainable from existing FORCEM output reports, or through the modification of FORCEM and the creation of additional reports from FORCEM. For other data, it may be appropriate to retain an existing postprocessor of CEM, or to develop an entirely new postprocessor. A review of all these processes is required along with the necessary modifications.

3. STUDY SPONSOR. US Army Concepts Analysis Agency (CAA).

4. STUDY AGENCY. Models Development Division, Analysis Support Directorate (AS), CAA.

5. TERMS OF REFERENCE

a. Scope. This study is limited to output data needed for the OMNIBUS and TAA studies performed by Forces Directorate (FO), and for the requirements studies performed by Requirements Directorate (RQ). In particular, output data are needed for the following areas:

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(1) CSS functions, primarily those represented in the existing Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS) Postprocessor.

(2) Casualties, as represented in the family of three existing postprocessors--Patient Flow Model, Casualty Stratification Model, and Readiness Indicator Model.

(3) Requirements for ammunition, as produced by the existing Ammunition Postprocessor (APP).

(4) Wartime Replacement Factors for equipment, as produced by the existing Materiel Postprocessor (MPP).

(5) Fuel Factors, as produced by the existing Fuel Factor Development Postprocessor.

(6) Combat Operational Readiness Float (CORF) Factors for equipment, as produced by the existing CORF Factors Postprocessor.

(7) Requirements for air defense missiles, intended output data from the developmental Air Defense Missile Postprocessor.

b. Objectives

(1) Determine the output data needed for studies using FORCEM.

(2) Ensure that the necessary output data for studies are available, by retaining (and possibly modifying) existing postprocessors, or by developing new postprocessors.

(3) Link FORCEM to retained and new postprocessors.

(4) Test FORCEM with postprocessors, and verify that results are "sensible."

(5) Make recommendations for long-term methodology development. This may be appropriate to improve the treatment of a particular concept (e.g., force roundout), or to achieve consistency between the representation of an activity within FORCEM and the representation of the same activity in a postprocessor.

c. Assumptions

(1) Regarding FASTALS, this study is limited to linking FORCEM to the existing FASTALS. This approach is adequate to support the application of FORCEM in the TAA-92 Study.

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(2) A more correct approach to FASTALS is to incorporate force buildup into FORCEM itself in order to account for the actual loading of the CSS system in the model. Developing such a methodology is a long-term effort that is not part of this study. (See also paragraph 5b(5) above.)

d. Essential Elements of Analysis

(1) What data are already available from FORCEM output reports, and what can be generated through the modification to FORCEM and the creation of new reports from FORCEM?

(2) Which existing postprocessors for CEM should be retained (and possibly modified), and which should be replaced?

(3) What computations performed in a postprocessor of CEM should be performed in FORCEM itself?

(4) Where FORCEM and a retained postprocessor both represent an activity, with perhaps differing methodologies, what can be done to achieve consistency?

6. RESPONSIBILITIES

a. Analysis Support Directorate (AS) has primary responsibility for accomplishment of the objectives listed in paragraph 5b. It will provide the study director. It will make all necessary modifications to FORCEM and will develop any necessary new postprocessors.

b. Forces Directorate (FO) will assist AS in the areas of CSS functions (paragraph 5a(1)) and casualties (paragraphs 5a(2)). It will specify output data needed for the OMNIBUS and TAA studies. It will assist in adapting FORCEM output to satisfy the input requirements of the appropriate existing postprocessors, will make necessary modifications to such postprocessors, and will advise in the development of necessary new postprocessors.

c. Requirements Directorate (RQ) will assist AS in areas of requirements (paragraphs 5a(3) through 5a(7)). It will specify output data needed for the requirements studies that it performs. It will assist in adapting FORCEM output to satisfy the input requirements of the appropriate existing postprocessors, will make necessary modifications to such post-processors, and will advise in the development of necessary new post-processors.

7. LITERATURE SEARCH. The following documents will be utilized in the study:

a. "User's Manual for Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS) Model," CAA Documentation CAA-D-83-4, Nov 83 (revised May 84).

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SUBJECT: Postprocessors for FORCEM (POSTFOR) Study

25 JAN 1985

b. "Patient Flow Model, Reference Manual," CAA Documentation CAA-D-82-1, Jul 82 (revised Mar 84).

c. "Reduction ATCAL Linkage Phase I Program," Models Applications Division, AS Directorate, Dec 84.

d. "Combat Unit Trace," internal CAA memorandum, MAJ D. K. Pearce, 31 Jan 77.

8. REFERENCES

a. AR 5-5, Army Studies and Analyses, November 1981.

b. DA Pam 5-5, Guidance for Army Study Sponsors, Sponsor's Study Directors, Study Advisory Groups, and Contracting Officer Representatives, April 1982.

9. ADMINISTRATION

a. Milestone Schedule. See CAA Form 59 (Inclosure 1).

b. Reporting. Models Development Division, AS, will submit DD Forms 1498 and 1473 to the Defense Technical Information Center, in accordance with AR 5-5 and DA Pam 5-5.

c. Documentation. The final report for the study will describe the treatment of each of the areas of paragraph 5a; in particular, whether a postprocessor is retained as is, modified (and how), or replaced. Each new postprocessor will be documented. The report will also describe recommendations for long-term methodology development that result from the study.

E. B. Vandiver

1 Incl
as

E. B. VANDIVER III
Director

CF:
Asst Dir, FO
Asst Dir, RQ

CAA Form 59

Study Scheduling Report

1. Study Number: 285438Z
   Sponsor: Director, CAA

2. Acronym: POSTFOR

3. Study Title: Postprocessors for FORCEM

4. Study Director:

5. Submission Date: Initial 850114 Revised

6. Start Date 850102 Completion Date 850415

7. Event/Activity:

Event/Activity	Start	End
Initial ARB	850122	850122
Determination of Output Requirements	841217	841231
Determination of which Postprocessors to retain, which to replace	850102	850112
Modifications to FORCEM	850115	850228
Development of New Postprocessors	850115	850228
Linking of FORCEM to Postprocessors	850216	850315
Testing of FO Postprocessors	850301	850331
Testing of RQ Postprocessors	850401	850517
Final ARB	850529	850529
Documentation	850301	850531

8. Date — Professional Staff Months (PSM)

Date	AS	FO	RQ
8412	1.5	0.25	0.25
8501	3.0	1.0	0.25
8603	4.0	1.5	0.25
8503	4.0	1.5	0.25
8504	1.5	0.25	0.75
8505	1.0	0.0	1.25

APPENDIX C

REFERENCES/BIBLIOGRAPHY

References

1. Combat Sample Generator (COSAGE) Ammunition Post Processor (APP) Linkage Program, Volume I, User's Manual (CALP-UM), CAA-D-83-2, US Army Concepts Analysis Agency, Bethesda, Maryland, Mar 83

2. Wartime Requirements for Ammunition, Materiel, and Personnel (WARRAMP), Volume III, Ammunition Post Processor, User's Manual (APP-UM), CAA-D-81-2, US Army Concepts Analysis Agency, Bethesda, Maryland, Dec 81

3. Memorandum for Record, CSCA-RSD, dated 15 Sep 86, subject: Operational Test of the Postprocessors for FORCEM (POSTFOR) (SECRET)

4. FORCEM in SRA - Preliminary Design, CAA-TP-86-11, US Army Concepts Analysis Agency, Bethesda, Maryland, 31 Oct 86 (draft)

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Combat Operational Readiness Float (CORF) Factors, CAA-SR-84-18, US Army Concepts Analysis Agency, Sep 84 (CONFIDENTAL)

Combat Sample Generator (COSAGE) Ammunition Post Processor (APP) Linkage Program, Volume II, Program Maintenance Manual (CALP-PMM), CAA-D-83-2, US Army Concepts Analysis Agency, Bethesda, Maryland, Mar 83

User's Manual for Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) Model, CAA-D-83-4, May 84

Wartime Requirements for Ammunition, Materiel, and Personnel (WARRAMP), Volume IV, Ammunition Post Processor Program Maintenance Manual (APP-PMM), CAA-D-81-2, US Army Concepts Analysis Agency, Bethesda, Maryland, Feb 82

APPENDIX D

FORCEM REPORTS USED BY POSTPROCESSORS

D-1. INTRODUCTION. This appendix describes briefly the contents of the FORCEM reports used by the POSTFOR routines and mentioned in this study report. They are listed in the order of their FORCEM report numbers. The FORCEM Division Equipment Report (R51) and Loss and Consumption Report (R64) are treated in detail because there are references in this report to particular fields of particular records of the R51 and R64 reports.

D-2. COMBAT HEADQUARTERS STATUS REPORT - PART 1 (R28). For every time period simulated, for every combat headquarters unit, the R28 report provides the side (Red or Blue), nationality, formation position (up, back, or reserve), echelon (theater, army, corps, or division), mission, combat worth of headquarters plus subordinates, friendly-to-enemy ratio of combat worth, current CSS state (percent), X-coordinate of center of unit front (in decameters), Y-coordinate of center of unit front (in decameters), width of the front of this headquarters, X-coordinate and Y-coordinate of the center of the unit rear, and identification number of the parent unit. These data are collected after the command and control and before any other activities of each FORCEM time period.

D-3. COMBAT HEADQUARTERS STATUS REPORT - TANKS (R30). The R30 report provides, for every time period simulated, for every combat headquarters, the side and the quantity onhand of each of the 12 types of tank.

D-4. COMBAT HEADQUARTERS STATUS REPORT - APCs (R31). The R31 report provides, for every time period simulated, for every combat headquarters, the side and the quantity onhand of each of the 12 types of APC.

D-5. COMBAT HEADQUARTERS STATUS REPORT - HELICOPTERS (R32). The R32 report provides, for every time period simulated, for every combat headquarters, the side and the quantity onhand of each of the five types of helicopter.

D-6. COMMAND AND CONTROL REPORT (R41). The R41 report provides, for every time period simulated, for every headquarters unit (theater, army, corps, or division), the echelon (theater, army, corps, or division); the side; the distance (kilometers) from the objective phase line (for corps, the distance that the army objective phase line is forward of the most forward division in the corps; for armies, the average of this distance across online subordinate corps); the formation position (up, back, or reserve); the number of subordinates up, back, and in reserve; the engagement status (engaged in direct fire combat, engaged in indirect fire combat, or not engaged); the posture (attack, defend, delay, or withdraw); the type of operation (movement to contact, hasty attack, deliberate attack, holding attack, counterattack defense, active defense, delay on successive positions, or voluntary withdrawal); the weighted force ratio; the engaged force ratio; the CSS state (percent) of the subordinate SUPCOM; and the CSS state of the combat headquarters.

D-7. AIR ROLE ASSIGNMENT REPORT (R42). The R42 report provides, for every time period simulated, for every FORCEM TACAIR headquarters (ATAF), the side, the quantity of aircraft apportioned by this ATAF to each of the five air roles (offensive counterair, defensive counterair, close air support (CAS), deep interdiction, and nuclear/chemical), and the quantity of sorties assigned to each of the specific missions (airbase attack, suppression of enemy air defense, interceptor, barrier/combat air patrol, CAS, deep interdiction, nuclear/chemical, escort, reconnaissance, and battlefield air interdiction).

D-8. AIR DEEP TARGET INTERDICTION REPORT (R43). For every time period simulated, for every deep interdiction mission, the R43 report provides the unit identification number of the ATAF controlling the strike; the side of the aircraft; the number of aircraft on the mission; the unit identification number of the target; the X-coordinate and Y-coordinate of the target unit location; the number of munition loads delivered on the target; the numbers of tanks, APCs, recovery vehicles, and artillery weapons damaged in the attack; the quantities of tank, artillery, special, and other ammunition destroyed in the attack; the quantities of POL, repair parts, and other supplies destroyed in the attack; the number of personnel casualties from the attack; and the national partition of the target unit.

D-9. COMBAT HEADQUARTERS STATUS REPORT - ANTITANK/MORTARS (R44). For every time period, for every combat headquarters, The R44 report provides the side and the quantity onhand of each of the 12 types of antitank/mortar weapons.

D-10. COMBAT HEADQUARTERS STATUS REPORT - PERSONNEL/ARTILLERY/CLOSE AIR SUPPORT (R45). For every time period, for every combat headquarters, the R45 report provides the quantities onhand of infantry, each type of artillery, and close air support aircraft.

D-11. DIVISION PERSONNEL REPORT (R49). For every Blue and Red division, for each of five times (beginning of cycle, after GS artillery, after air attacks, after combat and movement, and after CSS) every time period simulated, the R49 report provides the number and percent (of authorized) onhand of combat crew personnel, of dismounted infantry, of helicopter crew personnel, of support personnel, of "other personnel," and of artillery crew personnel.

D-12. DIVISION SUPPLY REPORT (R50). For every Blue and Red division, for each of five times every time period simulated, the R50 report provides the national partition and the quantity and percent (of authorized) onhand of tank ammunition, artillery ammunition, special ammunition, other ammunition, POL, and repair parts.

D-13. DIVISION EQUIPMENT REPORT (R51). The information is for divisions in the theater, including arriving divisions (even if not yet in the unit hierarchy). There are multiple records for a division each cycle, with a flag indicating when during the time cycle that data is captured. This report, as illustrated in Figure D-1, is used to generate the Division Intensity Report as input to the Force Analysis Simulation of Theater Administrative and Logistic Support (FASTALS) Model, using the fields for onhand combat worth, authorized combat worth, and percent combat personnel onhand, for those records with flags of 1 and 4.

.DATE 14 MAY 85 13:06:20 RID 8 14 MAY 85 C3
. 17-043042R64. FORCEM LOSS/EXPENDITURE REPORT

*TIME.NAT.ASS.ASS.ASS.SUB.FL	.AUTHORIZED/	.ONHAND/
*0+HR.ION.ET .TYP.CAT.CAT.AG	.CBT PERMLOSS.	CBT TEMPLOSS.
12 1 1 1 3 1 1	1392	1279
12 1 1 1 3 1 2	39	92
12 1 1 1 3 1 3	84151	0
12 1 2 2 3 1 1	2088	2058
12 1 2 2 3 1 2	2	4
12 1 2 2 3 1 3	117227	0
12 1 13 13 3 2 1	648	582
12 1 13 13 3 2 2	21	50
12 1 13 13 3 2 3	26627	0
12 1 14 14 3 2 1	1150	899
12 1 14 14 3 2 2	30	84
12 1 14 14 3 2 3	43699	0
12 1 17 17 3 2 1	180	180
12 1 17 17 3 2 3	8256	0
12 1 21 21 3 2 1	7022	3806
12 1 21 21 3 2 3	168502	0
12 1 23 23 3 2 1	1636	1416
12 1 23 23 3 2 2	45	116
12 1 23 23 3 2 3	69837	0
12 1 24 24 3 2 1	102	95
12 1 24 24 3 2 2	2	5
12 1 24 24 3 2 3	4121	0
12 1 25 25 3 3 1	348	309

E000710

.IN REPAIR/	.	.	.SORT
.NONC PERMLOS.	NONC TEMPLOS.	FIX FORWARD .	INDEX .
46	0	0	
0	0	25	
0	0	0	
17	0	0	
0	0	1	
0	0	0	
29	0	0	
0	0	13	
0	0	0	
62	0	0	
0	0	24	
0	0	0	
0	0	0	
0	0	0	
0	0	0	
111	0	0	
0	0	31	
0	0	0	
2	0	0	
0	0	2	
0	0	0	
23	0	0	

Figure D-1. Sample Division Equipment Report

TIME	Simulation time in hours when data was collected
UNIT ID	Division unit identification number
PART	Partition of force component; 1 = US Blue, 2 = non-US Blue; 3 = Red
FLAG	Flag indicating when during time cycle data is captured; values-- 1 = before activities (beginning of cycle) 2 = after GS artillery 3 = after air attacks 4 = after combat and movement 5 = after CSS (end of cycle)
TANKS NBR	Tanks onhand
PCT	Tanks onhand as a percent of authorized
APCS NBR	Armored personnel carriers onhand
PCT	Armored personnel carriers onhand as a percent of authorized
HELOS NBR	Helicopters onhand
PCT	Helicopters onhand as a percent of authorized
ATMS NBR	Antitank and mortars onhand
PCT	Antitank and mortars as a percent of authorized
ARTY NBR	Artillery onhand
PCT	Artillery onhand as a percent of authorized
CAS NBR	Close air support aircraft onhand
PCT	Close air support onhand as a percent of authorized*

*This percent will always be zero, since CAS is not an authorized division asset.

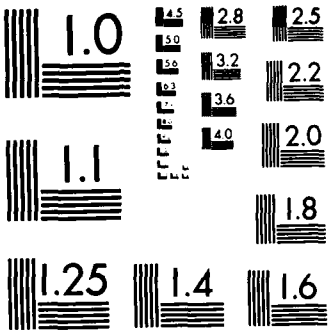
TRANS NBR	Transport vehicles onhand (trucks and recovery vehicles)
PCT	Transportation vehicles onhand as a percent of authorized
ONHND CBWOR	Total combat worth of onhand equipment. Does not include small arms or CAS
AUTH CBWOR	Total combat worth of authorized equipment. Does not include small arms or CAS
CB PER PCT	Percent of combat personnel onhand, i.e., ratio of onhand combat personnel to authorized combat personnel, expressed as a percent. Includes dismounted infantry, vehicle/weapon and helicopter crews, and artillery personnel

D-14. ARTILLERY DAMAGE REPORT (R52). For every GS artillery and surface-to-surface missile mission fired in the FORCEM simulation, the R52 report provides the simulation time, the identification number and side of the firing unit; the identification number of the target unit; the X-coordinate and Y-coordinate of the target unit location; the number of rounds delivered per engagement; the number of engagements; the numbers of tanks, APCs, trucks, recovery vehicles, and artillery weapons damaged by the mission; the quantities of tank ammunition, artillery ammunition, special ammunition, other ammunition, fuel, repair parts, and other supply destroyed by the mission; the number of personnel hit by the mission; and the national partition of the target unit.

D-15. ARTILLERY ALLOCATION REPORT (R61). For every time period simulated, for every nondivisional artillery or surface-to-surface missile (SSM) unit, the R61 report provides an indicator of whether the unit is allocated to direct or general support; the identification numbers of the unit supported by this unit and the parent headquarters of this unit; the side of this unit; an indicator of whether this is an artillery or SSM unit; and the onhand and authorized quantities of crew personnel, artillery tubes (or SSM launchers), and ammunition.

AD-A174 996 POSTPROCESSORS FOR THE FORCE EVALUATION MODEL (POSTFOR) 2/2
STUDY(U) ARMY CONCEPTS ANALYSIS AGENCY BETHESDA MD
R E JOHNSON SEP 86 CAA-SR-86-10

UNCLASSIFIED F/G 15/7 NL



D-16. LOSS AND CONSUMPTION REPORT (R64). This report (as shown in Figure D-2) provides data at each time cycle on every asset considered in the simulation. The data is used primarily to generate input for FASTALS, but can be of general analytical value as well. The data for a given asset are totals over all units in each nationality partition (force component such as US or non-US Blue) in the theater. Since the meaning of the data items in some columns of the report are different depending on the type of record (three types), column headings are not provided for all items. The following descriptions are given in four parts. The first part describes the first seven fields (columns) in each record, which are the same for all records. The other three parts describe the remaining five fields (8-12), which are different for the three record types.

FORCEM UNIT EQUIPMENT REPORT

TIME D+HRS	UNIT ID	PA RT	FL AG	TANKS NBR	TANKS PCT	APCS NBR	APCS PCT	HELOS NBR	HELOS PCT
0	101011	3	1	214	100	299	100	0	0
0	101012	3	1	214	100	299	100	0	0
0	2204	1	1	326	100	660	100	42	100
0	101013	3	1	214	100	299	100	0	0
0	2203	1	1	326	100	660	100	42	100
0	101014	3	1	214	100	299	100	0	0
0	2202	1	1	326	100	643	100	42	100
0	101015	3	1	328	100	280	100	12	100
0	2201	1	1	326	100	660	100	42	100
0	101022	3	1	214	100	299	100	0	0
0	101021	3	1	214	100	299	100	0	0
0	101023	3	1	328	100	280	100	12	100
0	2104	1	1	326	100	660	100	42	100
0	101024	3	1	214	100	299	100	0	0
0	101025	3	1	214	100	299	100	0	0
0	2103	1	1	326	100	660	100	42	100
0	2102	1	1	326	100	660	100	42	100
0	102011	3	1	214	100	299	100	0	0
0	2101	1	1	326	100	643	100	42	100
0	102012	3	1	214	100	299	100	0	0
0	102013	3	1	214	100	299	100	0	0
0	102014	3	1	328	100	280	100	12	100
0	1204	1	1	326	100	660	100	42	100
0	102015	3	1	214	100	299	100	0	0

ATMS NBR	ATMS PCT	ARTILLERY NBR	ARTILLERY PCT	CLOSE NBR	AIR PCT	TRANSPORT NBR	TRANSPORT PCT	ONHND CBWOR	AUTH CBWOR	CBPER PCT
680	100	150	100	0	0	150	100	200	200	100
680	100	150	100	0	0	150	100	200	200	100
288	100	66	100	0	0	1797	100	327	327	100
680	100	150	100	0	0	150	100	200	200	100
288	100	66	100	0	0	1797	100	327	327	100
680	100	150	100	0	0	150	100	200	200	100
267	100	75	100	0	0	1797	100	212	212	100
489	100	138	100	0	0	150	100	352	352	100
288	100	66	100	0	0	1797	100	327	327	100
680	100	150	100	0	0	150	100	200	200	100
680	100	150	100	0	0	150	100	200	200	100
489	100	138	100	0	0	150	100	352	352	100
288	100	66	100	0	0	1797	100	327	327	100
680	100	150	100	0	0	150	100	200	200	100
680	100	150	100	0	0	150	100	200	200	100
288	100	66	100	0	0	1797	100	327	327	100
288	100	66	100	0	0	1797	100	327	327	100
680	100	150	100	11	0	150	100	200	200	100
267	100	75	100	0	0	1797	100	212	212	100
680	100	150	100	0	0	150	100	200	200	100
680	100	150	100	23	0	150	100	200	200	100
489	100	138	100	0	0	150	100	352	352	100
288	100	66	100	0	0	1797	100	327	327	100
680	100	150	100	23	0	150	100	200	200	100

Figure D-2. Sample Loss and Consumption Report

General

TIME	The simulation time in hours when the data was collected. The initial, precycle zero data is indicated by a time of -12. For all values of TIME __0, data are as of the end of the time cycle
NATION	Partition or force component 1 = US Blue 2 = non-US Blue 3 = Red
ASSET	The asset index number
AST TYP	The asset type
AST CAT	The asset category
SUB CAT	The asset subcategory
FLAG	The record type (1-3)

Record Type 1

AUTHORIZED (Field 8)	The total number or amount of this asset authorized for all the units of this force partition.*
ON HAND (Field 9)	The total number or amount of this asset onhand at all the units of this force partition
IN REPAIR (Field 10)	The total number of assets in repair (for equipment assets) or in hospital (for personnel assets) this cycle
Field 11	Not currently used
Field 12	Not currently used

Record Type 2

CBT PERMLOSS (Field 8)	The total number or amount of permanent combat losses of the asset this cycle (personnel killed, vehicles destroyed, supplies consumed or destroyed)
CBT TEMPLOSS (Field 9)	The total number of temporary combat losses of the asset this cycle (personnel wounded or vehicles damaged)

---

*This total does not include authorized levels for equipment and personnel pools or for convoys since these values are artificial for those units.

NONC PERMLOSS (Field 10)	The total number or amount of permanent noncombat losses of the asset this cycle
NONC TEMPLOSS (Field 11)	The total number of temporary noncombat losses of the asset this cycle
FIX FORWARD (Field 12)	The total number of the asset "fixed forward" this cycle (aid station treatment for personnel or local maintenance for vehicles). The number is included in the total for fields 9 and 11 above

Record Type 3

Field 8	For equipment assets, the gallons of POL consumed by this equipment; this number is included in the total for fields 8 and 10 of record 2 of the corresponding POL asset. For personnel assets, the number of CMIA; this number is included in the total for field 8 of record 2
Field 9	The number of the equipment (or personnel) asset to return from repair (or medical treatment) this cycle
Field 10	The number of wounded personnel evacuated from the theater this cycle
Field 11	Not currently used
Field 12	Not currently used

NOTE: If fields 8-12 are all zero values at a given cycle, the output record is not generated.

D-17. OPERATIONAL READINESS FLOAT (ORF) REPORT (R65). For every issue of an ORF item of equipment from a SUPCOM unit to a receiving unit, the R65 report provides the simulation time when the issue was made, the simulation time when the ORF item was returned to the SUPCOM, the FORCEM unit identification number of the issuing SUPCOM, the FORCEM identification number of the receiving unit, the national partition of the receiving unit, the FORCEM asset number of the item issued, and the number of items issued.

D-18. TYPE OF ENGAGEMENT REPORT (R66). For every time period simulated, for every national partition (for example, 1 = US, 2 = non-US Blue, 3 = Red), the R66 report provides the number of divisions of this national partition involved in each of the following seven situations:

a. Blue attack, Red defend

b. Blue attack, Red delay

c. Red attack, Blue defend

d. Re(ttack, Blue delay

e. Static (engaged, but neither side attacks)

f. Not engaged, moving

g. Not engaged, not moving

D-19. INDIRECT FIRE AMMUNITION REPORT (R67). For every time period simulated, for every national partition, the R67 report provides the quantities of artillery ammunition (100 lb) and of air munitions delivered against this national partition in division engagements.

D-20. AMMUNITION CONSUMPTION REPORT (D36). For every time period simulated, for each of the two possible munitions of every FORCEM weapon type, for every national partition in which the weapon appears, the D36 report (as shown in Figure 5-4, Chapter 5) provides the number of rounds lost aboard weapons damaged by enemy fire in each of four postures (Blue delay, Blue defend, static, and Blue attack); the number of rounds expended in zeroing weapons in each of four events (units deploying, weapons returned to combat units from repair, weapons issued to combat units from equipment pools, and weapons returned to equipment pools from GS repair); the number of rounds expended in harassment and interdiction; the number of rounds lost in logistic losses; the number of rounds expended in rear security; the number of rounds expended in function checks or registration; the weight of the rounds consumed in all types of consumption; and the ammunition resupply pot from which this munition is drawn.

D-21. AMMUNITION FIRED REPORT (D37). For every time period simulated, for each of the two possible munitions of every FORCEM weapon type, for every national partition in which the weapon appears, for each of five engagement types (1 = Blue delay, 2 = Blue defend, 3 = static, 4 = Blue attack, 5 = nondivisional support), the D37 report (as shown in Figure 5-3, Chapter 5) provides the number of rounds fired at each of enemy personnel, tanks, helicopters, antitank/mortars, artillery, CAS, and at each of 12 possible types of enemy APC. The APCs are distinguished by type because the type of APC target can make a difference to the Ammunition Postprocessor. Rounds fired at no particular type of target appear in the personnel column.

APPENDIX E

ADDCOP DOCUMENTATION

E-1. INTRODUCTION. The text of this appendix is reproduced from an unpublished CAA document, which is the only existing documentation of the ADDCOP graphics postprocessor.

General

ADDCOP is a plotting program designed to produce line charts from specifically-formatted data sets. Some of the attributes of ADDCOP are:

1. Input data sets may be either data files or data elements.

2. Output may be generated for either the Tektronix terminal or Calcomp plotter.

3. Plot generation parameters may be entered interactively, in response to program prompts, or via batched, free-field parameter cards.

4. Batched parameter card sets may be automatically generated from interactive sessions.

5. Up to 100 data sets may be processed simultaneously, each containing a matrix of up to 90,000 variables (300 variables in each of two dimensions).

The data set format required by ADDCOP is that currently output by the CEM model, and is defined in detail in a later section. The data may be in fieldata or ASCII and may have up to 132 characters per record. There is no restriction on the generating program, as any SDF file or element may be used regardless of the source of the data.

Execution

Two versions of ADDCOP currently exist. These are ADDTEK, which generates Tektronix output, and ADDCAL, which generates output for the on-line Calcomp plotter. Both of these absolutes reside in file 67UTIL and are executed as processors (i.e., @67UTIL. ADDTEK or @67UTIL.ADDCAL). The format of the processor call is:

@ <program> , <options> <name2> , <name2> ,..., <name100>

Where <program> is either file.ADDTEK or file.ADDCAL, depending on the output device desired. Allowable <options> include any of those following:

B - Plotting parameters are to be input as batched parameter cards rather than interactively. Each plot is generated from a single parameter card and execution is terminated by end-of-file. The format of these cards is in Appendix B.

D - Convert to days. If this option is present and the X-axis label is "THEATER CYCLES", the X-axis label will be converted to "DAYS" and all X-axis data will be multiplied by 4.

* G - A data reference grid will be drawn in the data plotting area of each plot.

* H - A hardcopy of each plot will be automatically generated after each plot. This feature also turns off the viewing pauses generated before and after the generation of each plot. (Tektronix only)

* I - Numeric axis values will be truncated to integers. This option should be used with care as non-integer axis values will be drawn without fractional values (i.e., axis value 2.5 will be converted to 2).

* J - Triple-Roman (Jazzy) lettering will be used rather than the simple default lettering.

* M - Plot output will be generated in multiple colors. The sequence is:

    Line 1 = Black
    Line 2 = Red
    Line 3 = Blue
    Line 4 = Green
    LIne 5 = Black

    This option is available only on the Calcomp version.

  R - Rerun previous run. Using this option in conjunction with the B option causes ADDCOP to execute using the saved data file from a previous interactive execution of ADDCOP. When this option is used, no data set names are entered on the processor card, but are entered by the "*DS*" cards generated by the previous execution. See below.

  S - Save parameters. This option causes ADDCOP to generate a paramater deck for use in R-OPTION execution. This deck is written to file 27 and includes all data set names and parameters for plots which were interactively specified to be saved. After completion of S-OPTION execution, the execution may be rerun by entering:

    @ <program> , BR <other options>
    @ADD,E 27.

    The primary purpose of this feature is to allow users to preview plots on the TEKTRONIX terminal and to later generate these same plots on the CALCOMP Plotter.

* Z - Zero-anchor axis. When present, the Y-axis will always have its origin at Ø. If not present, an optimal choice will be made from the plot data.

Options marked with a '*' are options which may be changed during execution of ADDCOP in interactive mode.

In addition to the previous options, one of the following options is required for plot generation:

C - CALCOMP output (ADDCAL only). If selected, output is written to a catalogued scratch file with a program-generated external name and a @USE name of PLOT$. This output is plotted by entering @SYM PLOT$,, PLOT01 after ADDCOP execution. Just in case the CALCOMP output needs to be saved, the external filename is printed when the ADDCOP execution begins.

T - TEKTRONIX output (ADDTEK only). If selected, output is displayed on the TEKTRONIX terminal screen.

The previous two options exist to allow the ADDTEK and ADDCAL programs to be integrated into a single program, should this be possible in the future. If neither the C nor T options are specified, user help information is printed.

The names specified on the ADDCOP card are the names of up to 100 data sets to be used as sources of data. These data sets must be symbolic files or symbolic elements with a data format as specified in Annex E-I. All rules for specifying UNIVAC file or element names apply.

References to data sets specified are made according to their order on the ADDCOP processor card. The first data set specified is file 1. The second is file 2, and so on up to the 100 file limit. Information about each file is printed at processor execution in both batch and interactive execution modes. Also, in interactive mode, data set names and file numbers may be displayed by entering "?" when prompted for a file/variable combination.

Use Restrictions

As mentioned previously, ADDCOP can handle up to 100 data sets, each with a matrix of up to 300 by 300 variables. From the variables entered, any combination of 5 may be displayed on a single plot.

In addition to the above limits, the following ASCII Fortran unit numbers must be available for use by ADDCOP:

22 - GCS Font File (J-option only)
27 - Output Parameter File (S-option only)
28 - Data Paging File
29 - CALCOMP Output File (C-option only)

These unit numbers are reserved in the sense that ADDCOP will redefine these file units for its own use and any @USE assignments of these units before execution of ADDCOP will be changed during execution.

Annexes:

E-I - Data set format
E-II - Batched input parameter format

Examples:

A - Example data files
B - Batched plot generation (CALCOMP output)

EXAMPLE A

```
@prt,s 64data.supplies,.demands
FURPUR 28R3 U1 S74T11 09/14/82 14:36:06

UNCLASSIFIED*64DATA(0).SUPPLIES(2)
     1       (IGNORED)
     2           8    6
     3       (IGNORED)
     4       (IGNORED)
     5       (IGNORED)
     6       VOLUME
     7       PRICE
     8       (IGNORED)
     9       (IGNORED)
    10       SUPPLY OF PRODUCT 1
    11       SUPPLY OF PRODUCT 2
    12       SUPPLY OF PRODUCT 3
    13       SUPPLY OF PRODUCT 4
    14       SUPPLY OF PRODUCT 5
    15       SUPPLY OF PRODUCT 6
    16       (IGNORED)
    17       (8F10.3)
    18           10.000    20.000    30.000    40.000    50.000    60.000    70.000    80.000
    19           20.000    25.000    30.000    35.000    40.000    45.000    50.000    55.000
    20           30.000    33.000    36.000    39.000    42.000    45.000    48.000    51.000
    21           38.000    39.000    40.000    41.000    42.000    43.000    44.000    45.000
    22           00.000    15.000    30.000    45.000    60.000    75.000    90.000   105.000
    23           49.900    50.000    50.100    50.200    50.300    50.400    50.500    50.600

UNCLASSIFIED*64DATA(0).DEMANDS(3)
     1       (IGNORED)
     2           8    6
     3       (IGNORED)
     4       (IGNORED)
     5       (IGNORED)
     6       VOLUME
     7       PRICE
     8       (IGNORED)
     9       (IGNORED)
    10       DEMAND FOR PRODUCT 1
    11       DEMAND FOR PRODUCT 2
    12       DEMAND FOR PRODUCT 3
    13       DEMAND FOR PRODUCT 4
    14       DEMAND FOR PRODUCT 5
    15       DEMAND FOR PRODUCT 6
    16       (IGNORED)
    17       (8F10.3)
    18           80.000    70.000    60.000    50.000    40.000    30.000    20.000    10.000
    19           55.000    50.000    45.000    40.000    35.000    30.000    25.000    20.000
    20           51.000    48.000    45.000    42.000    39.000    36.000    33.000    30.000
    21           45.000    44.000    43.000    42.000    41.000    40.000    39.000    38.000
    22          105.000    90.000    75.000    60.000    45.000    30.000    15.000    00.000
    23           50.600    50.500    50.400    50.300    50.200    50.100    50.000    49.900
```

EXAMPLE B

```
$PRT,S TESTPLOTS

UNCLASSIFIED*TPF$(0).TESTPLOTS(0)
     1       'TEST PLOT # 1' 2 1,1 2,1
     2       'TEST PLOT # 2' 5 1,1 1,2 1,3 1,4 1,5



@67util.addcal,cmb 64data.supplies,,demands
CALCOMP ADDCOP 2R1 (CAA) 09/14/82 14:38:34

FILE  1             INPUT: 64DATA.SUPPLIES
                    X-AXIS LABEL:'VOLUME                              '
                    Y-AXIS LABEL:'PRICE                               '
                    VARIABLES READ:     6
                    RECORDS/VARIABLE:     8
                    LINES SKIPPED AFTER LAST VARIABLE READ:     0

FILE  2             INPUT: 64DATA.DEMANDS
                    X-AXIS LABEL:'VOLUME                              '
                    Y-AXIS LABEL:'PRICE                               '
                    VARIABLES READ:     6
                    RECORDS/VARIABLE:     8
                    LINES SKIPPED AFTER LAST VARIABLE READ:     0

**NOTE** CALCOMP OUTPUT SENT TO PLOT$ FILE $91482143835.
@add,e testplots

PLOT SPECIFICATION CARD #  1:
12345678901234567890123456789012345678901234567890123456789012345678901234567890
'TEST PLOT # 1' 2 1,1 2,1

      PLOT VALUES ARE:

              LETTER TYPE: QUICK          GRID DESIRED: NO
              TITLE IS 'TEST PLOT # 1                           '
          PLOTTING:
              FILE 1, VARIABLE  1         FILE 2, VARIABLE  1

PLOT SPECIFICATION CARD #  2:
12345678901234567890123456789012345678901234567890123456789012345678901234567890
'TEST PLOT # 2' 5 1,1 1,2 1,3 1,4 1,5

      PLOT VALUES ARE:

              LETTER TYPE: QUICK          GRID DESIRED: NO
              TITLE IS 'TEST PLOT # 2                           '
          PLOTTING:
              FILE 1, VARIABLE  1         FILE 1, VARIABLE  2
              FILE 1, VARIABLE  3         FILE 1, VARIABLE  4
              FILE 1, VARIABLE  5

END OF FILE ENCOUNTERED.
END ADDCOP.
```

ANNEX I TO APPENDIX E

DATA FORMAT

Data sets input to ADDCOP are expected to be in the following format:

'CARD'	COLUMNS	USE
1		IGNORED
2	1-5 6-10	Number of data values/variable (NP) Number of variables (NV)
3-5		IGNORED
6	1-32	X-axis label
7	1-32	Y-axis label
3-9		IGNORED
10 for NV	1-32	Variable label
10+NV	1-80	ASCII Fortran format of data
11+NV to end	(to format)	Data values. All data for first variable are listed, followed by data for second variable, etc.

When reading data, records are read until NP+NV values are read. All records read after this are skipped, and the number of records skipped is printed with the input data information.

ANNEX II TO APPENDIX E

BATCHED INPUT PARAMETER

In batched input mode, each plot is generated by a single free-field parameter card. The format of the card is:

'Title' NPR F1,V1 F2,V2 ... F5, V5

Where:

'Title' is the title of the plot, enclosed in single quotes. The title may be up to 32 characters in length.

NPR is the number of file-variable pairs to be plotted. It must be an integer in the range 1 through 5 inclusive.

Fn, Vn are up to 5 pairs of integers signifying the variables to be plotted. The first number in the pair is the file number, and the second is the variable number. Only NPR pairs must be specified.

Each input parameter card will be printed and scanned for errors. Plots will not be generated for cards in error.

APPENDIX F

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GLOSSARY

1. ABBREVIATIONS, ACRONYMS, AND SHORT TERMS

APC	armored personnel carrier (includes light armored vehicles such as the Bradley fighting vehicle (BFV) and the improved TOW vehicle (ITV))
ASCII	American Standard Code for Information Interchange (includes standards for computer programing languages)
ATCAL	the attrition calibration algorithm used to determine losses in division engagements in FORCEM
AT/M	antitank/mortar weapons
CAA	US Army Concepts Analysis Agency
CORF	Combat Operational Readiness Float
CSS	combat service support
EEA	essential element(s) of analysis
ESD	equivalent stylized day (APP terminology for a shooter-target combination)
FEBA	forward edge of the battle area
FORTRAN	a programing language (from FORmula TRANslator)
LIN	line item number
LOC	line of communication
LOGSACS	Logistical Structure and Composition System, an automated data base of the US Army
ORF	Operational Readiness Float, equipment used to replace Army equipment being repaired
POL	petroleum, oils, and lubricants (fuel)
POSTFOR	the Postprocessors for FORCEM Study
SIMSCRIPT	a programing and simulation language
SUPCOM	support complex, an aggregation of CSS units in FORCEM

TAA	Total Army Analysis, a recurring study of required US Army support units
TACAIR	tactical aircraft
TOE	Table(s) of Organization and Equipment
WAFF	wartime fuel factors
WARF	wartime replacement factors, for equipment destroyed in combat

2. COMPUTER PROGRAMS AND MODELS

ADDCOP	Automated Data Display of CEM Output Program, used to graph campaign simulation results
ADMP	Air Defense Missile Postprocessor, developed at CAA in 1986 to calculate air defense munition requirements from a CEM simulation
APP	Ammunition Postprocessor, used to compute ammunition requirements
CEM	Concepts Evaluation Model, the principal production model used at CAA for conducting campaign simulations of a theater of operations
COSAGE	Combat Sample Generator, used to simulate combat of a division-size force, to produce attrition and expenditures for campaign simulations and for APP and WARF postprocessors
FASTALS	Force Analysis Simulation of Theater Administrative and Logistics Support, the force roundout postprocessor used by CAA
FORCEM	Force Evaluation Model, CAA's recently-developed theater campaign simulation model

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